OpenKnowledge

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Emergency Monitoring Service Cluster

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OpenKnowledge Deliverable 6.6: Emergency Response GIS Service Cluster

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Abstract. In this document we first recall the organizational model for the specific selected use case ("Flooding in Trentino, Italy") as well as the detailed analysis of the roles of the involved agents. Then, we focus our analysis on the geographical data management scenario, on the current status of available infrastructure and on the overall use case. At last we provide an in depth description and modeling of the selected use case together with the proposed service oriented architecture for a cluster of services supporting the realization of such "map request" use case.

1 Introduction

A number of different organizations are involved in an emergency scenario. A detailed analysis of the general organizational framework for emergency response has been presented in the OpenKnowledge Deliverable 6.5 [6]. Moreover, in the same document, two relevant sub-scenarios have been identified as relevant to the testing of the OpenKnowledge framework, namely:

Natural disaster emergency scenario In this scenario, we want to interface the OpenKnowledge framework and prototype system to real data, to current organizational models and legacy information systems in use in the actual management of local emergency response activities. We want to test the level of support that the proposed OpenKnowledge system can deliver to the specific issues of:
- fast and accurate discovery of relevant data present in separate sources and/or institutions;
- integration and real-time fusion of various datasets, created, annotated and maintained by different actors/agencies;
- support for the interoperability among the different organizational models and technological infrastructures.

Urban disaster emergency scenario In this scenario we want to use the Kobe simulator, in order to test the OpenKnowledge system in an internationally recognised and thoroughly tested simulation environment. Baseline results can be developed through running the simulator with only the built-in abilities of the agents. These baseline results can then be compared with results that are generated when parts of the OpenKnowledge system have been layered on top of the simulator. We thus have a clear empirical method of determining which aspects of OpenKnowledge improve emergency response in such a situation, as well as a means of comparing our work against the work of others.

In this document we are going to focus on the first sub-scenario - Natural disaster emergency scenario - and analyze, for the selected scenario, the current status of available services (GIS services) towards the identification of an appropriate service cluster to be used as test-bed for the OpenKnowledge framework.

The rest of the deliverable is organized as follows. Section 2 recalls the organizational model for the specific selected use case (”Flooding in Trentino, Italy”) and provides a detailed analysis of the roles of the involved agents. Section 3 analyzes the geographical data management scenario and in particular analyzes the current status of available infrastructure and overall use case. In Section 4 we select a relevant use case, namely the generic ”map request” use case, and provide an in depth description and modeling of the selected use case. In section 5 we propose the architecture for a cluster of services supporting the realization of the ”map request” use case. Section 6 concludes the report and addresses the plan for road-map for the activities to be carried out in Work-package 6 in 2007 in regard to the eResponse test-bed.

2 Organizational model for the selected Natural Disaster Scenario: Flooding in Trentino, Italy

In this section, we recall, for subsequent use, the overall organizationl model and the main actors involved in the selected emergency response scenario. Moreover, we describe the current Autonomous Province of Trento (PAT) Geographic Information System infrastructure useful to support the activity in the case of emergency response.

The main goal of this scenario, is to show how a system such as OpenKnowledge, in combination with an appropriate Spatial Data Infrastructure, could be used to manage the sharing of the relevant geographical information used in the coordination activities between the different actors involved in such an event. A more detailed description of the overall scenario is found in OpenKnowledge Deliverable 6.5 [6].

In an emergency situation in the Trentino region, there are two main levels of coordination [8]: the provincial level and the municipality level. Only in cases of extensive emergencies do other levels have to be coordinated (national level, European level, international aids) with the province (PAT) and municipality levels. For the case of our scenario, flooding emergency in Trentino, our scope is limited to the above two main levels. In the case of such a crisis a PAT (provincial level) Emergency Coordination Center is the responsible institution for the emergency response. This Coordination Center coordinates both the intervention of his fire teams (Fire Permanent Corps) and of all municipalities involved in the emergency scenario. Each of the municipalies has a local coordination center that maintains the contacts with the main coordination center and can use its own municipality fire team. Each municipality team can act inside the municipality territory and must be coordinate with the central fire team.

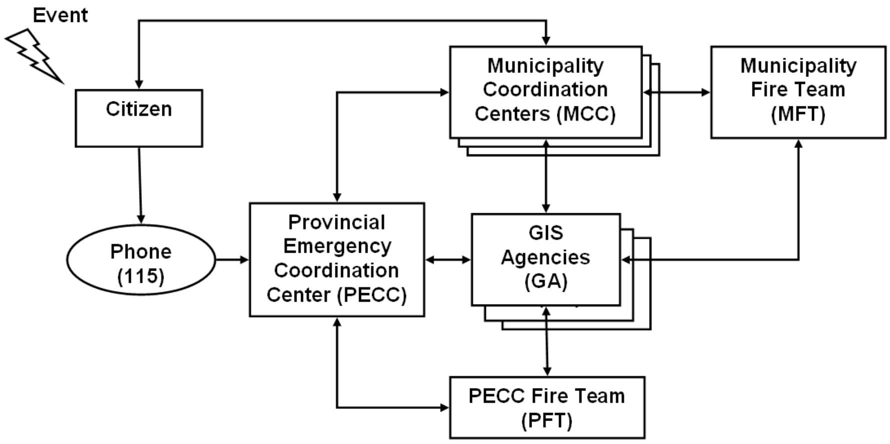

Fig. 1. Organizational Model for flooding emergency response in Trentino

Figure 1 depicts schematically the organizational model of the described scenario. The main actors, indicated in the current PAT emergency plan for a flooding event together with a short description of their main role, are:

- PECC: (P.A.T.) Emergency Coordination Center. Role: Coordination of all actors participating the emergency situation.
- COC: (Centro Operativo Comunale / Municipality Coordination Center). Role: coordinates the operations inside the municipality area. Could be more then one.
- FPC: (Fire Permanents Corps/ Fire Centre): Unique fire centre. Role: get information/tasks directly from PECC.
- TVC: (Trento Volunteers Corps/Municipality Fire Crew): One for each municipality. Role: get information/tasks from COC.
- GA: (GIS Agency). Role: providing geographic information, data and services.

For the purpose of the present document, we are interested in the details and roles of the GIS Agency (GA). The GIS Agency is responsible to provide geographic data-sets and services to external Service requestors: at present only to institutional actors (i.e. PECC, COCs, FPC, TVCs); in the future it is envisaged to extend the GIS agency services to more dynamic and numerous actors (military supporting teams, groups of technical/expert volunteers, organized groups of citizens).

The main generic actors in the current organization model of the GA Agency in Trentino, together with a short description of their main role, are:

- GA_SR: (GIS Agency Service Requestor). Role: ask for service (maps, datasets, analysis, etc).
- GA_SP: (GIS Agency Service Provider). Role: interface from external actors and internal GA actors. Service "Aggregator" (design time / run time).
- GA_DP: (GIS Agency Dataset Provider). Role: providing GIS datasets to requestors.
- GA_MAP: (GIS Agency Map Provider). Role: building geographical maps from a number of available sources of geodata (GeoDbs)
- GA_MEP: (GIS Agency Metadata Provider). Role: GIS metadata provider (formalized description, search, matching etc) from a number of available sources of geodata metadata (GeoDBs)

Figure 2 summarizes in a diagram the simplified organizational view of the GIS Agency together with the associated main roles

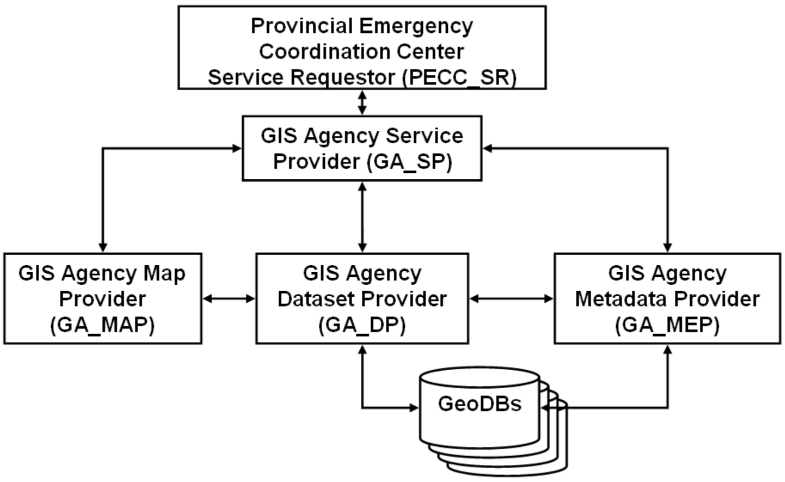

Fig. 2. GIS Agency Organizational Model

From the flooding emergency scenario situated in Trentino and in the surrounding areas, we have chosen to focus on the GIS Agency management subscenario. Briefly, the GIS management scenario consists in the coordination and GIS data integration and distribution among the GIS agencies of PAT. The GIS data peers provide the GIS data to the GIS data requestor. The main issue here is that every agency produces a large number of data-sets, but, even if they are published as "public data", often the availability of the data isn't known by the other agencies. Moreover, the agencies could provide some additional services (conversion between different coordinate systems, digital maps, ...) but most often they do not explicitly provide at present the sequence of operations needed in order to use those functionalities. In the next section we analyzes the current status of the available infrastructure and overall use case and discuss the main interoperability issues involved.

3 Geographical data management scenario: from GIS to SDI infrastructure

From an operational point of view, the main goals of a GIS Agency are:

- manage the internal geo-data and geo-services repositories
- respond to generic queries on spatial data from generic service requestors

Typical service requestors roles include:

- Public institution that requires geographic information to support institutional duties (e.g. emergency, etc).
- International, National or local institution that coordinates and integrates geographic information provided by different GIS agencies
- Research institution that wants to analyze the availability and the quality level of geographic information covering a specific study area.
- Private company that needs geographic information in order to create business services and products (geo-marketing)
- Non expert user, that needs to locate quickly and easily a geographical feature (address, location name, institution, business activity, etc).

To support all these kinds of users, and users' requests', GIS agencies around the world have started to adopt a Spatial Data Infrastructure (SDI) model (see for instance [1], [3] and [7]). While a GIS is a self-contained system in which data and software applications are used mainly internally, the SDI goal is to support the interoperability among different kinds of institutions, users and roles. The following features more precisely define an SDI:

- It is an IT infrastructure intended to create an environment in which all stakeholders (from users to producers) can cooperate with each other using the ICT, to better achieve their spatial data objectives at different personal, political and administrative levels.
- It permits sharing of data, and therefore it enables users to save resources, time and effort when trying to acquire certified and relevant spatial information.
- It creates a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, commercial sector, nonprofit sector, academia and for citizens in general.

In an SDI the keyword becomes “sharing”. Spatial Data Infrastructure can be defined in fact as “framework of policies, institutional arrangements, technologies, data, and people that enable the effective sharing of geographic information” [1].

It is important to underline that data integration is not a priority in traditional GIS: usually inside a single GIS agency all users share the same environment (GIS software package, format, coordinate system, data precision, lineage procedures, etc). Due to this uniform environment, few activities are needed to integrate data. However, interoperability problems arises when these data have to be exchanged with other GIS institutions.

On the contrary, the main goal for a SDI is to facilitate data sharing among different GIS institution. So, the main efforts are dedicated to build an environment where data integration is a (semi)-automatic task. In the SDI case the services provides by one or more data or services providers have to be coordinated to compose complex applications. The basic services can be heterogeneous and often the Web Services paradigm can be adopted with success as a common and coordination layer.

As an example of SDI in practice, the following picture shows the organizational model of the distributed GIS Agency infrastructure of the Autonomous Province of Trento.The framework of the distributed system is actually represented by a number of GIS agencies: civilian protection, urban planning, forestry, viability, environmental protection, cadaster, geological survey. Each GIS agency is responsible for a subset of the geographic information for the Autonomous Province of Trento. To support interoperability among the different GIS Agencies the regional information infrastructure is shifting from a traditional GIS system to a modern Spatial Data Infrastructure.

Both geographic data sharing and geographic services usage are pervaded by geographical information interoperability problems. In order to better identify these issues, a separate analysis for geographic data (geo-data) interoperability and geographic services (geo-services) interoperability is useful.

Geo-data interoperability: one of the key services supplied by a SDI is the possibility to retrieve geographical dataset provided by heterogeneous resources. Heterogeneity issues are common for a distributed system, but geographical datasets have specific properties, different from other types of data [5]. Among others:

- *Multiple versions:* multiple versions of the same entities on the Earth's surface can differ radically in terms of data model, scale, data generalization, and the conceptual models the data col-lectors use. Important semantic differences are also involved in the data, which are mostly collected by different government agencies.
- *Implicit linking:*in general, explicit references must be present to combine information in a meaningful manner. However, geographic information enables linking without explicit references, for instance via coordinate reference systems.

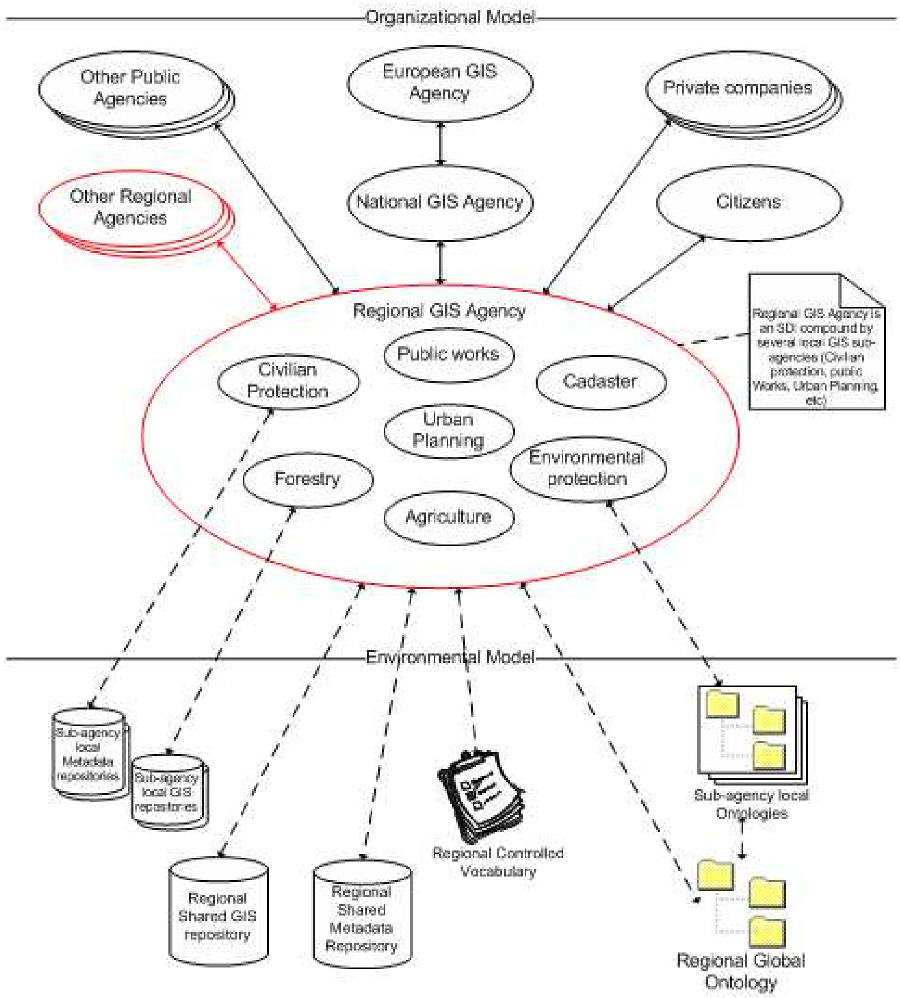

Fig. 3. Organizational model of the Trentino GIS Agency infrastructure

- *Massive data sets:* compared to general (administrative) information, geo-information can be massive. In case of satellite imagery, for instance, the raster data volumes are also huge.
- *Maps as implicit interfaces:* everyone is familiar with reading maps, so they're a natural human-machine interface for the services interacting with the user and presenting (intermediate) results of geo-information.
- *Geometry based information:* because geo-information is geometry based, it's possible to apply a whole set of common mathematical tools in geo-services (such as to compute the distance between two objects or com-

pute the buffer around an object).

Due to the fact that the logical architecture of a SDI is based on a set of heterogeneous data resources, heterogeneous geographical information has to be integrated. Since each geo-data producer adopts internal rules in order to manage its geographical datasets, heterogeneity at the data level arises for a number of of different reasons:

- *Different physical data formats:* geo-datasets are stored using file systems, or geo-databases, different sources (OGC specification compliant, legacy systems, etc), different data formats (”spaghetti” format like AutoCAD DWG, ESRI shape files, OGC Geographic Markup Language, etc).
- *Different production processes:* requirements for geo-datasets acquisition are different even if they are referred to the same geographical feature. Additional factors have also to be considered like integration alignment problem (due to different geographic projections, data collected at different scales, corrected using different elevation models, data production using different topographic sources).
- *Different representation/resolution:* each data source collects geo-datasets using a specific representation of the real word to fit requirements of the data producer. Often the same geographic feature is represented using different geometric features (for instance roads can be represented using polygons or lines) or multi-temporal techniques [9].
- *Different schemas/ontologies:* geographical features can be represented using different geometrical and data schemas. Heterogeneity of the data include structural heterogeneity (schematic heterogeneity) and semantic heterogeneity (data heterogeneity). Ontologies can be used to reduce geographic information heterogeneity [2]. An ontology (see [4] for details) is a logical theory accounting for the intended meaning of a formal vocabulary (i.e., its ontological commitment to a particular concept of the world). However, different geographical data providers may use different application ontologies, so, heterogeneity problems arise when integrating the information from different application ontologies.

Geo-services interoperability Distributed services oriented architecture is a common framework for modern information systems. Heterogeneous services' coordination is one of the main research topics in the field of web services. In the specific case of geo-services, which is no different from normal services, geo-services coordination includes:

- *Geo-services discovery*: GIS desktop applications provides to the user a number of complex functions in order to perform GIS data acquisition, creation, analysis, visualizing and mapping. For years these functions were accessible only through the GIS desktop application, but recently, GIS services have been published and made available on the web. Service Oriented Architecture (SOA) and OGC specifications are the base technology used by SDI in order to provide catalogue services for discovering appropriate data and services for a specific task. As in normal services, three building blocks are central in GIS SOA: a GIS user community (GIS services' users), GIS Web services (provided by some GIS service providers) and a GIS catalog service (where available services are published by providers and discovered by users). It is important to note that at present the majority of these kind of services are US-based. In Europe, government, institutions and local GIS agencies are just starting to provide such openly accessible spatial services.

– *Geo-services integration*: after discovery, services can be composed to provide complex functionality. Although at present, the main available web service in GIS is the map request service, the trend is to supply a technological environment that provides a number of stand-alone GIS services. At the moment, the majority of these geo-services exist as single services. In the case of a request for a complex service a manual and static composition of a number of basic geo-services has to be performed. The future challenge is the (semi)-automatic composition of the services in order to obtain flexible complex services based on the available web services. In practice, however, chaining geographic services is a nontrivial task, mostly because of interoperability problems among geo-services.

From a technological point of view, few problems exist when discovering and integrating available web services: SOA for business services and OGC specifications for geographic information represent the proper framework and technological solution for this kind of problems. But as in the case of geodata, also geo-services are defined using implicit or, in the best case, local application ontologies. At present, no standard notions are used for defining the semantics of a geographic web service: the kind of the service, the number, name and the position of the input parameters and output parameters are totally independent from one GIS services provider to another. Semantic heterogeneity (the differences in meaning) problem is an actual challenge also for geographic services integration. Currently, geo-information search is performed using mainly string-matching techniques. Using natural language techniques could improve the semantic relevance of search results. However, current approaches are inherently restricted by the ambiguities of natural language, which leads to low precision and/or recall.

We believe, that the OpenKnowledge approach to a lightweight form of knowledge sharing could be effective in the solution of the above mentioned interoperability issues. Therefore we think that the proposed use case - geographical data management scenario - is going to provide a useful test-bed to the OpenKnowledge prototype system.

In the last part of this section we will briefly discuss the overall use case for the Trentino Spatial Data Infrastructure management scenario. The comprehensive use case is presented schematically in Figure 4. The diagram illustrates common users, and related groups of operations, namely:

Internal Professional/Technical Users . This group of users consists of the internal power users that builds simple and composed services, manage the information system and verify and certify the technical quality of the datasets and related metadata. They are also responsible for the management of common vocabularies and, where available, shared ontologies.

Internal Administrative Users . This group of users consists of the users authorized and capable to design, create and update geo-datasets. They are also responsible for the metadata creation related to their geo-datasets.

Internal Normal Users .These users are the internal final users of the SDI and essentially can perform query for maps and datasets. They usually have specific competencies and knowledge of the domain as well as of the technical implementation and common rules within the organization.

External Users: Professionals/Citizens These users are the external final users of the SDI. They also essentially perform query for maps and datasets. Differently from internal users, they do not have specific competencies and knowledge of the domain nor knowledge of the technical implementation and common rules within the organization.

4 Generic Map Request Service

Within the general Trentino Spatial Data Infrastructure management scenario, in our work we have identified the most commonly used specific use case, i.e. Map Request Service. This use-case is the first that we will explore within the OK project.

In the following, the selected use-case is presented and analyzed in detail. Moreover we also provide an in depth description of the design and implementation issues for a cluster of services supporting the realization of this use case.

Here we focus on one particular - but the most common - request that can be made by the service requestor agent (GA_SR in Figure 2): a digital map request. A service requestor - both in emergency or normal situation - needs to visualize a map of a region with a number of user selectable geographical information. Therefore, the searched map is a composition of different geographic layers offered by the service provider agent (GA_SP in figure 2). Figure 5 presents the generic map request service use case at a high level of abstraction.

As indicated in the figure, the map request operation can be made using three different techniques: static map, dynamic map, semantic query. Alongside the common functionalities offered by the navigation user interface of a digital map (zoom-in, zoom-out, zoom-extent, pan), each technique offers the following functionalities:

– *Static map:* the user asks for a map that is already present in the system (static map). This map is prepared at design time by the GIS Agency Map Provider. The number layers and the legend are fixed. The user can navigate

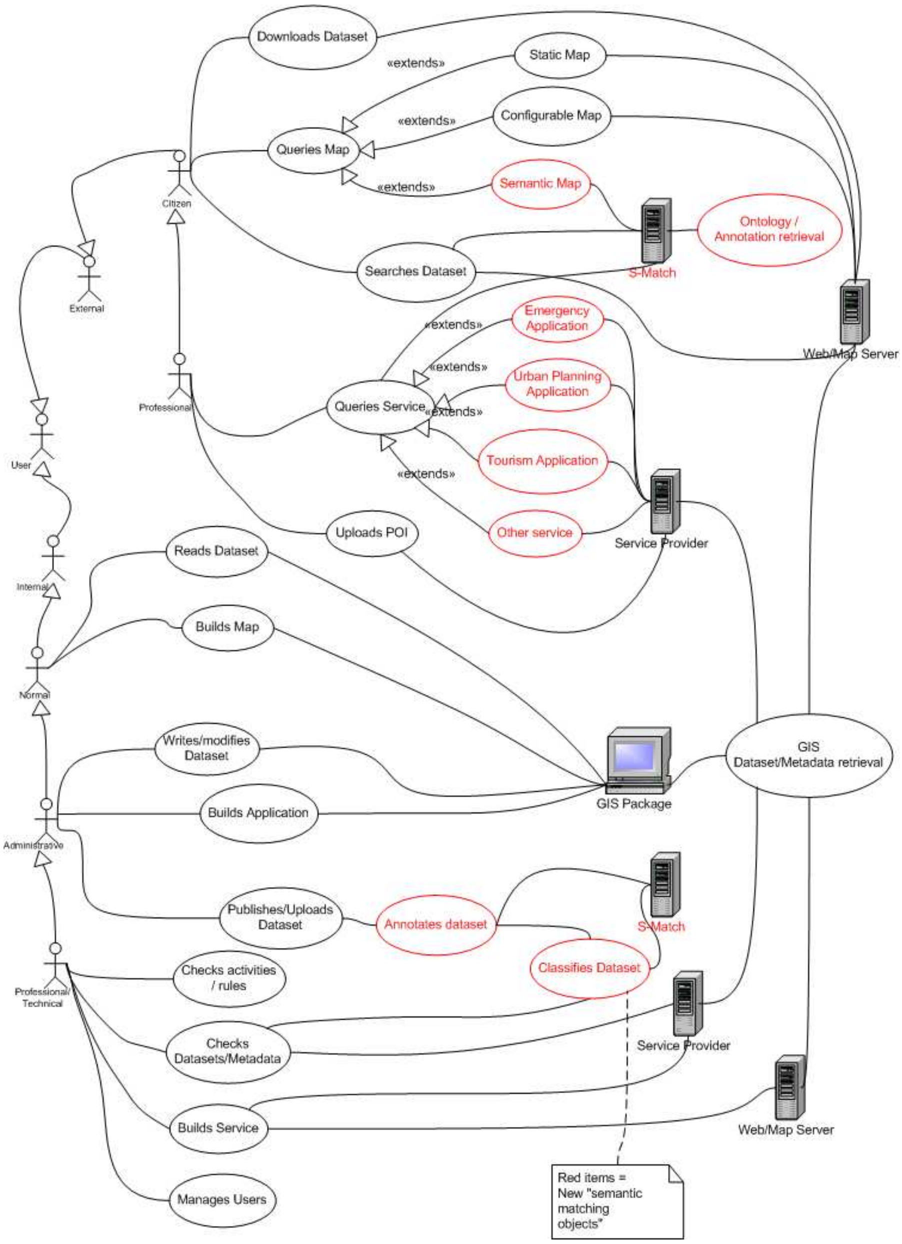

Fig. 4. General SDI scenario

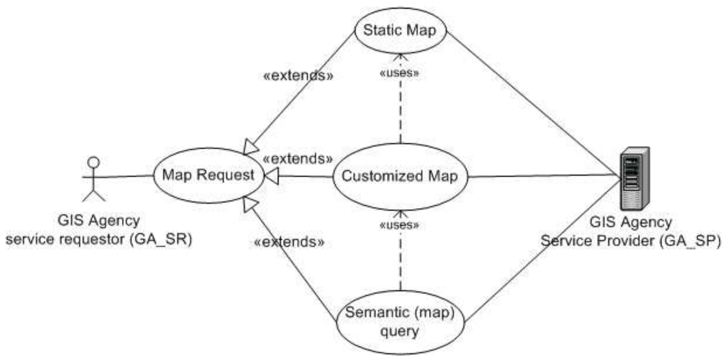

Fig. 5. Map Request Service Use Case

(zoom-in , zoom-out, zoom-extent, pan) and enable/disable the visualization of the static layers represented in the map.

- *Dynamic map:* the user knows the list of datasets provided by the GIS agency. Thus, he/she selects the datasets that fit his/her needs and the system provides a map representing these layers.
- *Semantic Query and Dynamic Map:* if the user does not know about the datasets of the GIS agency it need to input a "semantic query" to the Service provider. For example, the user can ask for "a map of all hydrant locations for the Municipality of Trento". The service provider can ask the user more information about its needs. Then it will use this information to build one or more maps that could fit the user needs.

A simplified interaction for the generic Map Request Service is illustrated in the sequence diagram in Figure 6. The diagram models a query of a map from an external requestor:

- The requestor assumes the GA_SR role and it asks to the service provider (GA_SP) the list of the available datasets. The requestor asks a map that contains a number of relevant thematic layers (selected datasets), covering the emergency area (for instance: topographic map, public buildings, cultural and heritages buildings, viability, railroad and roads, hydrography network , bridges, etc).
- The service provider (GA_SP), in order to provide the requested service, needs to query the metadata provider (GA_MEP) for metadata information about the requested location and specific layers.
- The metadata provider (GA_MEP) first identify the particular location and then tries to locate the requested layers (geo-datasets). It then returns its finding to the service provider.
- The service provider (GA_SP) selects the right layers and asks for a compound map and legend the map provider (GA_MAP).

– The map provider (GA_MAP) builds the legend and the map of the requested location and returns it to service provider (GA_SP).
– Finally, the service provider (GA_SP) sends the map and the legend to the service requestor (GA_SR).

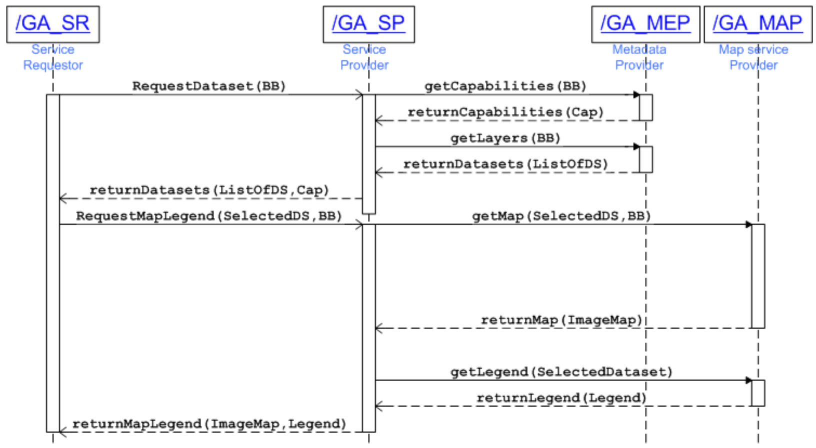

Fig. 6. Sequence Diagram for the Map Request Service

Figure 7 shows, as an example, a fragment of the interaction model described in LCC for the sequence diagram described above.

5 Web Service Cluster: towards the implementation of the Map Request Service use case

In figure 8, we present our proposed service oriented architecture for the implementation of a concrete map request service procedure. To this end, first the user inputs a location identifier, usually a string. If the name of the place is recognized by the system, the system returns its (geographical) position or a list of possible - similar - locations. Thus the user can refine his (geographical) query and proceed to query a number of other information (datasets/layers) for the location. The returned position, datasets, scale, and datasets legend are used as parameters to build the map. Moreover the user can ask for downloading some of the available datasets.

We propose to separate the main activity into three individual services:

– **The Gazeteer Service:** the user searches for a string into the system toponym repository(ies). The gazeteer service returns a list of toponyms that contain the input string. The user chooses one of the location names and

$$
\begin{array}{l}
a(ga\_sr, R) :: \\
\quad requestDatasets(BB) \Rightarrow a(ga\_sp, P) \leftarrow needMap(BB)\ then \\
\quad \left(\begin{array}{l}
returnDatasets(LD) \Leftarrow a(ga\_sp, P)\ then \\
requestMapLegend(SD, BB) \Rightarrow a(ga\_sp, P) \leftarrow select(SD, LD)\ then \\
returnMapLegend(IM, L) \Leftarrow a(ga\_sp, P)\ or \\
noDatasets(SD) \Leftarrow a(ga\_sp, P)
\end{array} \right)\ or \\
\quad noMapServer(BB) \Leftarrow a(ga\_sp, P)
\end{array}
$$

$$
\begin{array}{l}
a(ga\_sp, P) :: \\
\quad requestDatasets(BB) \Leftarrow a(ga\_sr, R)\ then \\
\quad getCapabilities \Rightarrow a(ga\_mep, E)\ then \\
\quad returnCapabilities(Cap) \Leftarrow a(ga\_mep, E)\ then \\
\quad getLayers \Rightarrow a(ga\_mep, E) \leftarrow checkMapServer(Cap) \wedge checkBoundingBox(Cap, BB)\ then \\
\quad \left(\begin{array}{l}
returnListOfDatasets(LD) \Leftarrow a(ga\_mep, E)\ then \\
returnDatasets(LD) \Rightarrow a(ga\_sr, R)\ then \\
requestMapLegend(SD, BB) \Leftarrow a(ga\_sr, R)\ then \\
getMap(SD, BB) \Rightarrow a(ga\_map, A) \leftarrow subset(SD, LD)\ then \\
\left(\begin{array}{l}
returnMap(IM) \Leftarrow a(ga\_map, A)\ then \\
getLegend(SD) \Rightarrow a(ga\_map, A)\ then \\
returnLegend(L) \Leftarrow a(ga\_map, A)\ then \\
returnMapLegend(IM, L) \Rightarrow a(ga\_sr, R)
\end{array} \right)\ or \\
noDatasets(SD) \Rightarrow a(ga\_sr, R)
\end{array} \right)\ or \\
\quad noMapServer(BB) \Rightarrow a(ga\_sr, R)
\end{array}
$$

$$
\begin{array}{l}
a(ga\_mep, E) :: \\
\quad \left(\begin{array}{l}
getCapabilities \Leftarrow a(ga\_sp, P)\ then \\
returnCapabilities(Cap) \Rightarrow a(ga\_sp, P) \leftarrow provide(Cap)
\end{array} \right)\ or \\
\quad \left(\begin{array}{l}
getLayers \Leftarrow a(ga\_sp, P)\ then \\
returnListOfDatasets(LD) \Rightarrow a(ga\_sp, P) \leftarrow provideListOfDatasets(LD)
\end{array} \right)
\end{array}
$$

$$
\begin{array}{l}
a(ga\_map, A) :: \\
\quad \left(\begin{array}{l}
getMap(SD, BB) \Leftarrow a(ga\_sp, P)\ then \\
returnMap(IM) \Rightarrow a(ga\_sp, P) \leftarrow buildMap(IM, BB)
\end{array} \right)\ or \\
\quad \left(\begin{array}{l}
getLegend(SD) \Leftarrow a(ga\_sp, P)\ then \\
returnLegend(L) \Rightarrow a(ga\_sp, P) \leftarrow buildLegend(L, SD)
\end{array} \right)
\end{array}
$$

Fig. 7. Example of Interaction Model for the Map Request Service

asks the system for the position. The system outputs the geographic coordinates of the toponym. Figure 9 shows the proposed activity diagram for the Gazeteer Service.
Please note that this is a first simplified schema. The service could become more complex, for instance:

- it could return the coordinates in a different geographic coordinate system. In this case it should be capable to address a web service that transforms the geographic coordinates to the desired coordinate systems.

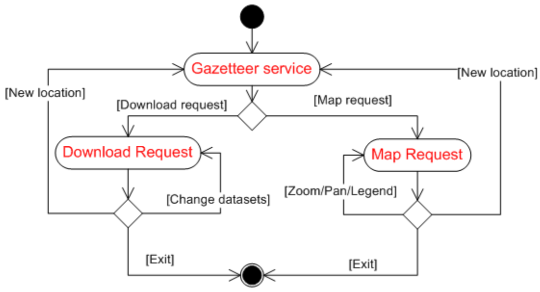

Fig. 8. Overall Architecture for Map Request Service

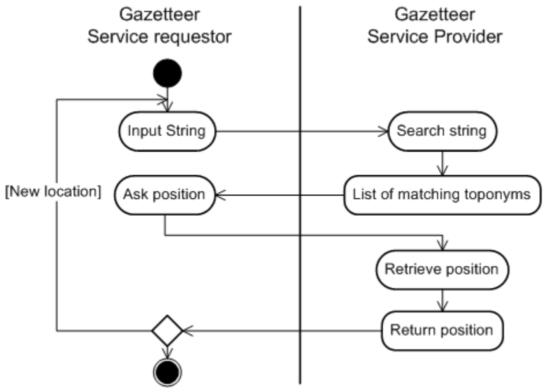

Fig. 9. Activity Diagram for the Gazeteer Service

- it could extend the search from toponym to general word description of places, like "Churches, Municipalities, Shops ..". In this case a semantic matching could be performed in order to search for related concepts in the metadata repositories and than again in the system toponym repository.

– **The (core) Map Request Service:** the user asks for a map. He/she gives the Map Provider Service the coordinates of the center of the map (the toponym position), the precision scale, and the layers he/she wants to visualize. The map provider computes the boundary of the map and builds the digital map. Finally it returns the map to the requestor. Figure 10 shows the proposed activity diagram for the Map Request Service.
Also in this service model some important extension will be considered, in particular the support for "semantic queries" for the desired information, for instance queries like "Provide me with the map of all gasoline stations near Trento"

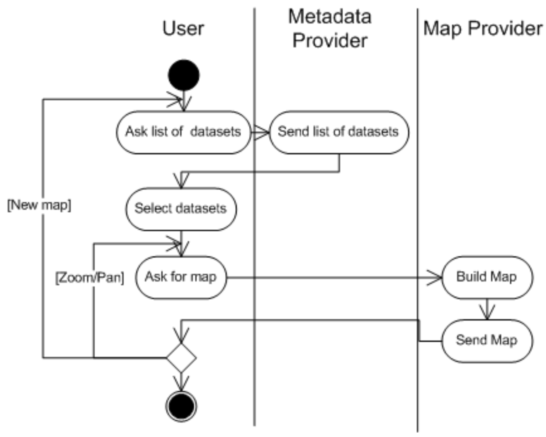

Fig. 10. Activity Diagram for the Map Request Service

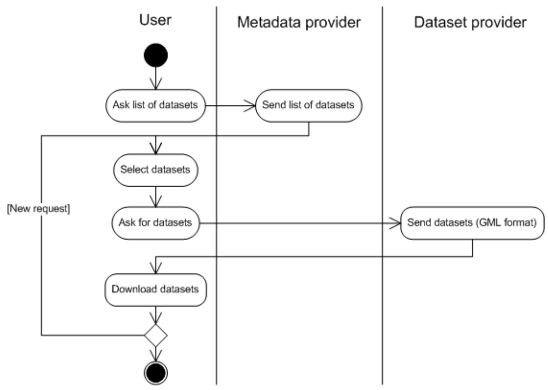

Fig. 11. Activity Diagram for the Download Request Service

– **The Download Service:** the user can ask for geographical datasets stored into the system. The user first selects the layers he/she wants to download, then the dataset provider sends these layers to the users. In our case the interchange format is assumed to be the GML format, a special XML dialect for geo datasets. Figure 11 illustrates the proposed activity diagram for the Map Request Service.
Again, also in this service model some extensions will be considered to support semantic searches of the relevant geo datasets, when the user is not aware of the internal vocabularies or schemas.

In this reporting period, our work has been focused on the definition of the service interfaces and related WSDL files for the proposed Web Service cluster implementing the generic Map Request Service. Current designed sequence/interaction diagram and related WSDL files are included - for reference - in Annex 1.

6 Roadmap for 2007

Our plan for the main activities in 2007 for the eResponse testbed is the following:

Full implementation of the test-bed The main effort in this direction will be in the actual implementation of the Map Request Services clusters descried in this document and in Annex 1. An important task will also be in the grounding of the selected use-case on the real data (digital, maps, datasets and metadata) available in the local region (Trentino).

Integration with OpenKnowledge framework Our goal is to use the selected use-case(s) as test-bed for the OpenKnowledge approach. In particular we want to use OpenKnowledge as user interface paradigm for supporting semantic searches on both services and data available in a network of GIS agencies. To this end, main effort will be devoted to:

- model all service cluster sequence diagram with LCC interaction models
- integrate the developing services cluster with the first OK prototype

Question/answering issues In current scenarios - e.g., services discovery, data integration - it is assumed that queries are specified by using the terminology of a global schema. However, in open environments users are free to pose queries by using their own terminology. In such cases,for instance, an information integration system has to interpret (rewrite) the terms used in the query, into the predefined ontology entities of the system. This rewriting can be viewed as matching. The rest of the query answering process usually proceeds in a similar way as in the normal data integration scenario.
In this respect, we will test in the eResponse use-case current approaches in semantic matching in distributed settings.

Ontology evolution It is natural that domains of interest, application requirements and the way in which knowledge engineers conceptualize those by means of ontologies undergo changes and evolve over time. Also, ontology development, similar to software code development, is often performed in a distributed and collaborative manner. Therefore, multiple versions of the same ontology often exist. Some applications keep their ontologies up to date, while others may continue to use old ontology versions and update them on their own. These situations arise because knowledge engineers and developers usually do not have a global view of how and where the ontologies have changed. In fact, change logs may not always be available (which

is often the case in distributed ontology development). Therefore, developers need to manage and maintain the different versions of their ontologies.
This is also true for the geographic data management scenario and we will investigate these issues within a related use-case, namely the geo-data life-cycle management use-case and connected service cluster. The life cycle of geo-data in an SDI can be divided into two main parts: the set of activities useful to the local production and management of the geographical dataset (Local GIS management) and the set of tasks that allows data sharing between the SDI stakeholders (shared SDI management).
Following current discussion with local SDI stakeholders, the support to this use-case is considered - in their current activity - the subsequent priority, after the Map Request scenario.

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