Open geo-data for innovative services and user applications towards Smart Cities. The GeoSmartCity portuguese pilot.

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Abstract

The ICT-PSP European project GeoSmartCity establishes a cross-platform, able to publish open GI and to provide specialized services based on open standards services protocols. This paper presents the GeoSmartCity project and particularly the portuguese pilot. The project is an open infrastructure extended to the smart cities paradigm. Based on the "scenarios and use cases analysis and requirements" task the Oeiras portuguese underground and green-energy scenarios are described. The results shown in this paper for Oeiras pilot opened new challenges to the project, specially the question of publishing the data itself as Linked Open Data, by exploring the suitability of GeoSPARQL and RDF project.

Keywords: Open geo-data, innovative services, smart cities.

1 Introduction

Smart City management requires integration of geographic data from many and heterogeneous sources, spanning from pan-European open data sets (as from the Public Sector Information and the INSPIRE Directives) to local data with "home-made" semantics. In order to analyse and visualize geographic information (GI) through these data sets, it is necessary to integrate the data in terms of formats, access protocols, transformation and coordinate reference system, data harmonization.

The ICT-PSP European project GeoSmartCity is an open infrastructure extended to the smart cities paradigm [3] and has the following objectives:

- Support the cities professionals and citizens supplying "open data"
- Establishing a reusable platform for publishing geographic open data, within a urban context but with an European dimension;
- Availability of tools and functionalities for integrating geographic open data;
- Services for sharing and integrating restricted geographic data with cities geographic open data.

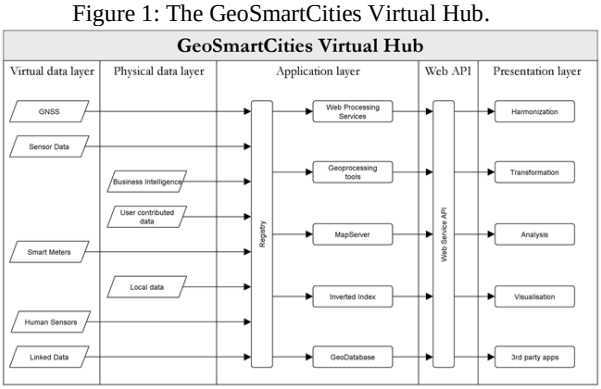
The project has several work packages and is now finishing the "system architecture and data content" and the "data infrastructure and management functions" work packages.

The remainder of this paper is structured as follows: first we present the GeoSmarCity project describing the scenarios, the services and the pilots. Based on the "scenarios and use cases analysis and requirements" task the following sections describe the Oeiras portuguese underground and green-energy scenarios. Conclusions and future tasks of the project will be presented in the last section of this paper.

2 GeoSmartCity project

The ICT-PSP European project GeoSmartCity establishes a cross-platform, able to publish open GI and to provide specialized services based on open standards services protocols. Starting by the availability of the open GI through open standards, the hub (Figure 1) gives the possibility to integrate them with other public/private data in order to design the specialized services needed to implement addressed Smart City scenarios.

Figure 1: The GeoSmartCities Virtual Hub.



From the logical point of view the GeoSmartCities Virtual Hub is organized in five layers. The virtual data layer includes all GNSS data, sensor data, smart meters, human sensors (including crowdsourcing) and linked data. The physical data layer includes all data stored in the organizations GIS servers, business intelligence and local data. The application layer will include a registry service, the web processing services, the dedicated geoprocessing tools designed from the pilots requirements, the map server, inverted index and geodatabase that will store the data used for the different services that will

be implemented. The next layer of the GeoSmartCities Virtual Hub is the Web API that will work as bridge between the application layer and the presentation layer. The last layer is the presentation layer and includes different components like the harmonization, the transformation, the analysis and visualization component.

The result will be a consistent repository of GI that can be spatially and semantically cross-analyzed to provide an accurate and up-to-date view of the respective problem domains.

GeoSmartCity leverages the use of open (geo)data as recommended by the EU Open Data Strategy and starts from PSI and INSPIRE Directives data infrastructures, with an emphasis on Municipalities as service and data providers to professionals and citizens.

GeoSmartCity fosters the creation of added-value by the integration of urban open data with third-party data (open or restricted) as well as crowd-sourced data. Exploitation of heterogeneous (open) GI data is possible thanks to the connection of different consolidated standards (linked data, INSPIRE, Sensor data, GNSS), allowing open cross-sector interoperability between different data providers and domains and the consequent creation of a wide range of user-driven application scenarios.

2.1 Scenarios

The potentiality of the toolkit will be demonstrated through the development of 11 operative and re-usable pilot cases in the frame of two scenarios:

1) Green-Energy, to support public energy policy makers, to facilitate the management of renewable energy plants within cities, to promote buildings energy retrofit (buildings are responsible for the 40% of all energy consumption) in order to support the energy transition strategy, to reduce CO2 emissions, and to develop local energy saving economy. The Green Energy scenario intends to support the Covenant of Mayors;
2) Underground, to support integrated management of urban underground utility infrastructures in different sectors sharing the same work environment and background geo-information, produced and/or held by public bodies and fostering the private-public partnership in city infrastructure planning and management. To integrate underground data with territorial data to search for assets located in risk zones (hydrogeological, hydraulic, seismic…), needing for specific monitoring and control.

These pilot cases will demonstrate the possibility to apply the GeoSmartCity Hub and its specialized services in different areas and municipalities, guaranteeing the exploitability and the long term viability of the proposed solution, in new cities and sectors..

2.2 Innovative services

The development of specialized services based on open standards will be structured in the following priorities and characteristics:

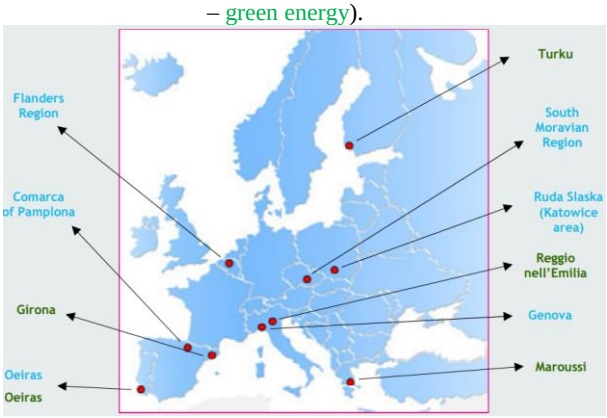
1) Service platform to view, analyze, extract data from the GeoSmartcity OpenData Hub.
   a. Open standard based service to view, analyse extract GI open data (WFS, WMS, WCS) [1].
   b. WFS to RDF (linked data) data transformation
   c. SPARQL end point.
   d. Basic geographic data visualization services.
   e. Basic tabular data visualization services.
2) Universal discovery services.
   a. GI Open Standard discovery services (CSW).
   b. Non GI Open data discovery services.
3) Business Intelligence and geoprocessing service platform.
   a. Spatio temporal geoprocessing services.
   b. Standard Geoprocessing services.
   c. Basic Business intelligence services.
   d. Advanced Business Intelligence services.
4) Ingestion and data integration engine.
   a. Harmonised data storage (based on GI standard, open data format) and a set of ingestion and data relation services mainly composed by an ingestion toolkit of GI data (open/restricted), an ingestion toolkit of not-GI data (open/restricted), refine and reconcile toolkit to link and interconnect data.
   b. Crowd-sourcing base services based on location services.

2.3 Pilots

Together with the GI open data repository and the GeoSmartCity hub, there will be the availability of a set of 11 operative and re-usable pilot cases in the frame of Green Energy and Underground scenarios demonstrating the possibility to replicate the proposed pilot cases in different areas and municipalities, guaranteeing the exploitability and the long term viability of the proposed solution. Each pilot will build added value services based on the GeoSmartCity hub that will be locally exploited.

Overall 11 Cities/Regions (with centralized management of services for the cities in the region) are involved in the project. Each City will implement a pilot in the frame of one of the above scenarios.

Figure 2: City Pilots and Scenarios (underground – green energy).



3 The Portuguese pilot

Oeiras (Portugal) is a city near Lisbon and is the only pilot in the GeoSmartCity project that is developing two pilots. For the development of the two pilots a user requirement analysis was adopted. The methodology for sorting the requirements was based on a small survey delivered at the local stakeholders involved (municipality, water and sewage company, local energy agency). The survey was organized in the following items:

I. Data input requirements
II. Storage requirements
III. Data processing requirements
IV. Data output requirements
VI. Performance requirements

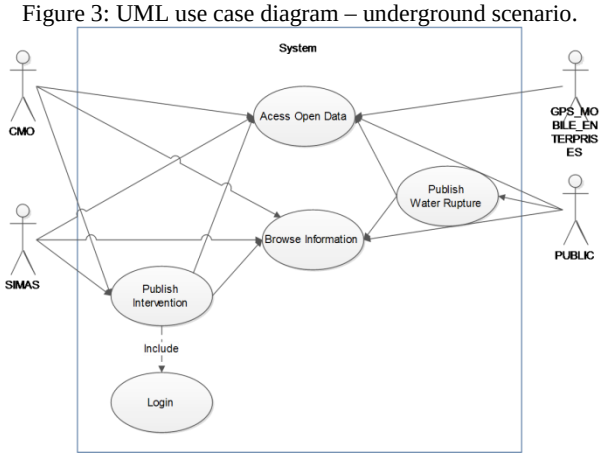
The following points describe the pilots' overview, the use cases adopted and the main user/functional requirements.

3.1 Underground scenario

For the underground scenario the water and sewage company established only one use case. This use case was designated as "Underground Event Management". With the implementation of an event management platform Oeiras municipality hopes to create a more efficient warning system of interruptions in public roads, reduce traffic and CO2 emissions and optimize the management of the underground. Water and sewage company, wants to reduce downtime service and reduce water losses.

It is intended that the system will function as a mobile crowdsourcing platform for characterization and location of ruptures in water network. The system should also serve as a disclosure platform to publish traffic interruptions. These inputs will be made by the municipality. Water and sewage company will use the system for dissemination of interventions in the water and sewerage network, as well as to communicate, to all registered users via SMS / Mail, information about service downtime in the water and sewage networks. The System shall serve as a Metadata and Open Data provider through Web Services (WMS, WCS, ...). GPS Mobile Enterprises could use data from traffic interruptions available to integrate into their platforms. In Figure 3 the UML Activity diagram for underground use case is described.

Figure 3: UML use case diagram – underground scenario.



3.2 Green Energy scenario

For the green-energy scenario the main stakeholders (municipality and local energy agency) established three use cases. With the implementation of the platform the municipality of Oeiras hopes to improve the use of renewable energy among citizens. At the planning level expects to create an energy efficient city.

The first use case is designated "Urban Sustainable Planning Tool". In this use case it will be possible to calculate the Solar Potential of roof and façade for future buildings. This process will be done through the upload of the building(s) project in CityGML format and the system will automatic calculate the renewable energy potential of that building.

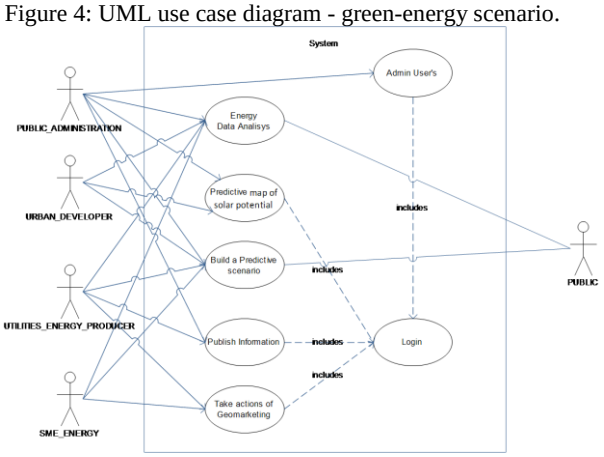
The Zero-balance calculation use case should have the ability to calculate solar potential for buildings at the block scale, using the initial solar potential map and also the estimated consumption at the block scale. With these data the system will produce Smart Grids with the energy balance for the territory using the block scale.

The third use case is the "Calculation of energy performance (EPBD class energy) at building level". For this use case the EPBD class energy for the buildings footprint will be mapped using three different approaches. The first approach will use the existing energy certificates provided by the National Energy Agency. The second approach will be supported by a model that is being developed by SINERGIS partner that will be based on the building physical characteristics (building age, number of floors…). The last approach for mapping the class energy is based on the building owner communication and with the Hub.

For the three use cases the system shall serve as a Metadata and Open Data provider through Web Services (WMS, WCS, ...).

In Figure 4 the UML Activity diagram for green-energy use cases is described

Figure 4: UML use case diagram - green-energy scenario.



4 Conclusions and outlook

GeoSmartCity Hub will be a community's software and the business model will be based on the development of extensions, applications and services as well as geo-statistical analysis. The non-proprietary platform will also foster

increased emphasis on standardization and interoperability of detailed, local data that do not conform to generic standards for European data sets.

With the scenarios and use cases analysis and requirements done in Oeiras, a data inventory was realized in order to evaluate the data harmonization procedure and the existing metadata compliance with the INSPIRE Directive [2].

At this stage of the GeoSmartCity project implementation, the evaluation on publishing the data itself as Linked Open Data, by exploring the suitability of GeoSPARQL and RDF is a priority. Simultaneously, the logical and the physical architecture of the GeoSmartCity hub were established in order to prepare the implementation of the next tasks, particularly the specialized services design.

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