A spatial data infrastructure for Portuguese National Health Plan – GEOSAÚDE

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Introduction

Portuguese National Health Plan (NHP) encompasses a perspective of integration and development of information systems in order to: empower the several levels of decision-making to identify potential health gains and priority interventions; monitor activity and performance of the Health System.

Accordingly to these objectives, a project team focused on creating a Spatial Data Infrastructure (SDI) to support an interactive health mapping platform, publicly available on the web. This infrastructure was designed in agreement to the INSPIRE Directive standards, particularly the metadata standards, the interoperability of spatial datasets and network services.

We set out to describe the SDI behind the Portuguese interactive health mapping platform, GeoSaúde.

Methods

The Portuguese NHP SDI takes advantage of Open GeoSpatial Consortium (OGC) standards as a tool to achieve INSPIRE compliancy in three major areas: Discovery, View Services and Interoperability.

The Spatial Data Infrastructure which supports the GeoSaúde platform was built as a client-server model, where the clients perform http requests to a main server through a web-browser (figure 1). Two different versions of GeoSaúde were developed: a desktop version and a version for mobile devices (tablets) that allows access to the platform on mobile environments. The client-server communication is achieved through REST[1] services and the server response uses the JSON[2] format.

[1] http://en.wikipedia.org/wiki/Representational_state_transfer
[2] http://www.json.org/

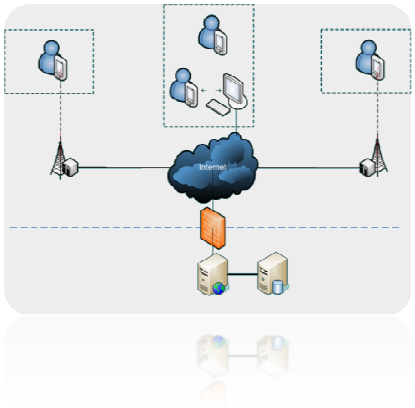

Figure 1 – Hardware architecture

The hardware infrastructure (application and database) was built upon the Amazon Elastic Computing Cloud service taking advantage of this kind of service availability and scalability.

Regarding the software architecture (Figure 2), all the Spatial Data Infrastructure is based on open-source technology. Both for the application and database servers, the chosen operating system was the Ubuntu Server 12.04. As the Relational Database System, the choice was PostgreSQL with the PostGIS version 1.5 which allows the support of geospatial data. The WMS Server used to provide the geographic information to the clients was Mapserver[3]. All the georeferenced information (maps) requests made to Mapserver use the OGC's WMS standard. Besides its high performance as a WMS Server, Mapserver also allows compliance with two implementations of INSPIRE, in particular the INSPIRE View Service and the INSPIRE Download Service which were built upon WMS and WFS standards. The platform's application logic was developed by Novageo Solutions and uses the niuGIS Metrics software. As application software for managing the geospatial information on the web browsers, the choices were OpenLayers 2.12 version and the ExtJS library 4.1.1 version.

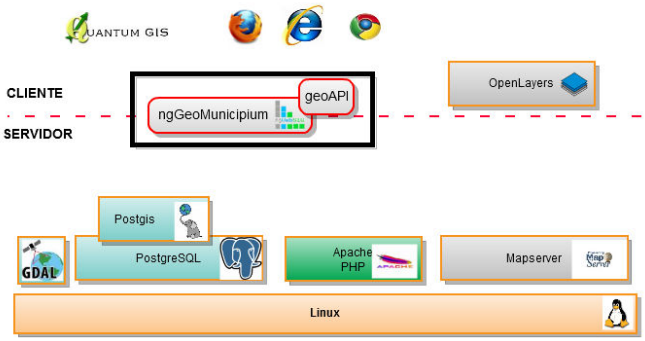

Figure 2: Software Architecture

[3] http://mapserver.org/

The spatial datasets that are part of the NHP lie within the annex III data themes – Human Health and Safety[4]. They include spatio-temporal components, reflecting the nature of health indicators. Health determinant data were represented by statistical aggregation of raw measurements data reported on several statistical units (Figure 3).

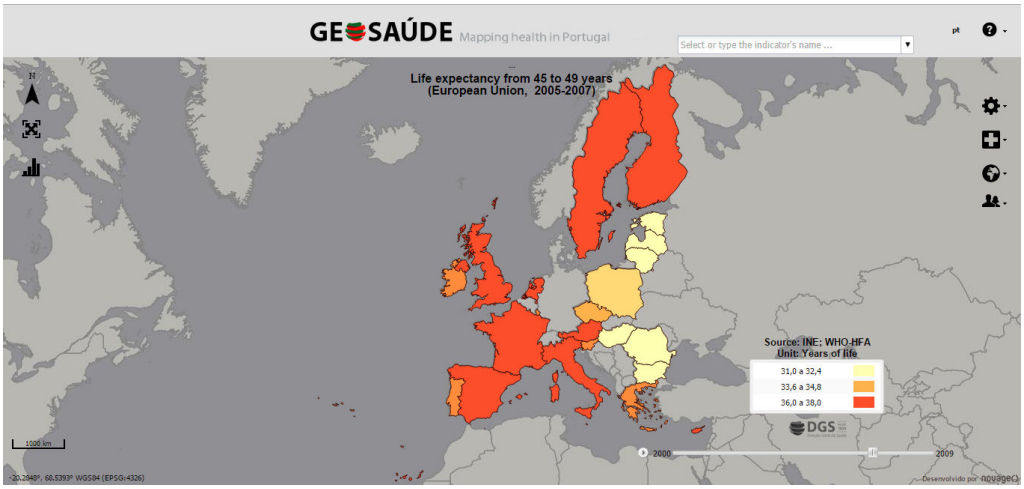

Figure 3 – GeoSaúde – Life Expectancy from 45 to 49 years (European Union 2005 - 2007)

Following INSPIRE requirements, the data were harmonized and standardized, creating the building blocks on which software and OGC standards were applied.

Particularly, two mandatory attributes (disease measure and reference period) and one voidable attribute (gender) were present on the GeoSaúde datasets. Age range were considered, not as an attribute, but were denormalized as different health indicator. Other INSPIRE requirements were ensured, namely:

- Health determinant statistical data were modelled as health statistical data characterized by a measurement value based on ISO/TS 19103:2005 and a statistical aggregation method – the metadata for each health indicator is available;
- Regarding coordinate reference system, the datum was the European Terrestrial Reference System (ETRS 89). WGS 84 and ETRS 89/TM06 were available for display, as well.
- Temporal reference system

Some features which can improve the following versions of GeoSaúde were also identified, particularly those arising from the INSPIRE data specification for "Saúde e Segurança Humana" (Human Health and Safety).

[4] http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_HH_v3.0.pdf

- The ICD Value[5] code list should be used to identify the disease name, meaning that code list used by the HH user community, managed by WHO[6].
- Age range should be used as voidable attribute.

Results

INSPIRE Directives concerning to full interoperability (e.g. catalogue services and view services) have been implemented with OGC standards. The created interoperable SDI can be freely accessed by health information users: querying, viewing and analyzing spatial health datasets in time, space and sex dimensions are possible. All datasets, once dispersed by several repositories, are now centralized in a single datacenter, allowing a high level of data quality.

Conclusion

INSPIRE interoperability rules, regarding the Portuguese NHP, were supported on OGC standards and open source geospatial software. INSPIRE standardization and harmonization rules were applied. OGC standards and open source software created the platform for data discovery and visualization. The adoption of OGC compliant open source software greatly facilitated the implementation of INSPIRE Directives. INSPIRE Directives, OGC standards and open source software operating together allowed for greater interoperability, vendor independence and ease of maintenance.

[5] http://inspire.ec.europa.eu/codelist/ICDValue/
[6] http://www.who.int