EUROGEOSOURCE, CLOUD TECHNOLOGY BRINGS DISTRIBUTED WEB GIS SYSTEMS TO ANDROID

Stephan H.L.L. Gruijters [(1)]

(1) TNO – Geological Survey of the Netherlands, a. PO Box 80015 3508 TA UTRECHT the Netherlands. Stephan.gruijters@tno.nl

KEY WORDS: cloud computing, data harmonisation, distributed web system, INSPIRE, mineral resources, energy resources.

INTRODUCTION

A central problem Europe is facing today is to secure its energy and non-energetic minerals supply. EU authorities currently compile their long-term policies regarding the need for oil, gas and minerals, including estimates of the required import, from national reports contributed by the member countries. These reports contain only generalized information regarding reserves and production forecasts for a country as a whole and do not allow a fast response to crisis situations and significantly reduce the accuracy of the long-term planning of the geo-energy supply of Europe. Furthermore the way the data is available; users can not query the data interactively, or combine it with their own spatial datasets for more complex analysis.

To address this issue the EuroGeoSource (EGS) project is building a multilingual web GIS system that will allow users to identify access, use and reuse aggregated geographical information on geo energy and mineral resources provided by geological surveys from at least ten countries in Europe. The system will enable services for the registration of data sets from different countries, the visualization and overlay of the information layers obtained from distributed sources, spatial analysis, and so on.

This paper will focus on the INSPIRE compliant data model and the technical design of the system.

HARMONISED DATA MODEL

The set of key attributes is grouped in general data of the site, data of location, administrative data, economic data and additional data (see figure 1). Attributes specific to mineral resources are labelled (M) to energy resources (E) and to both (M&E). Not all attributes are available and or accessible for each country. The data are mapped to the INSPIRE data specifications for the themes geology, minerals, energy and administrative units, leaving twenty-one attributes that could not be mapped. The mapping showed that the connection between the different data themes and the rationale within each theme in INSPIRE is not yet optimal, resulting in multiple references our redundancy when entering data. These insights is reported to the INSPIRE thematic working groups in detail to improve the final versions (3.0) of the data specifications.

GENERAL DATA OF SITE	DATA OF LOCATION	ADMINISTRATIVE DATA
INSPIRE ID of site (M&E)	Coordinates: longitude, latitude (M&E)	licence ID (M&E)
local ID (M&E)	depth below surface (M&E)	type of licence (M&E)
Name of site (M&E)	water depth (M&E)	Name of licencee / operator (M&E)
Name of site (M&E)	geographical location (M&E)	Duration of licence (M&E)
Type of resource (M&E)	Country name (M&E)	Areal extent of licence (M&E)
Year of discovery (M&E)		
status of site (M&E)		
References (M&E)		
Remarks (M&E)		
ECONOMIC DATA	**ADDITIONAL DATA**	**ADDITIONAL DATA**
Classification (M&E)	Geological characteristics regional / of field (M&E)	Main type of field (E)
in situ ore / substance reserves (M&E)	Age of host rock / Reservoir rock age (M&E)	Status (E)
Production (M)	Host Rock type / Reservoir rock type (M&E)	Nr of oil producing wells (E)
Period of Production (M)	mineral deposit type (M)	Nr of gas producing wells (E)
Dimension of the deposit (M)	primary comodities (M)	Nr of gas injecting wells (E)
mining method (M)	secondary comodities (M)	Nr of oil/gas producing wells (E)
Oil Initially in Place (E)	main ore minerals / substance (M)	Nr of water injecting wells (E)
Gas Initially in Place (E)	secondary ore minerals / substance (M)	Nr of water/gas injecting wells (E)
Cumulative oil production (E)		Nr of CO2 injecting wells (E)
Cumulative gas production (E)	hydrothermal alteration (M)	Nr of producing/injecting wells (E)
Cumulative water production (E)	morphology of the deposit (M)	Areal extent of field delimitation (E)
Cumulative gas injection (E)	regional deposit structure (M)	Reservoir depth (E)
Cumulative water injection (E)	dating method of mineralisation (M)	Production strategy (E)
Remaining Oil reserves (E)	age of mineralisation (M)	Installations (E)
Remaning Gas reserves (E)		
Year of reporting (E)		

Figure 1 – Attributes in harmonsed data model for mineral resources (M), energy resources (E) or both (M&E).

In order to distribute and portray the data two service types are installed at each geological survey. One service for filtering and requesting the data itself (Web Feature Service, WFS) and one for portraying the information as a geographical map (Web Mapping service, WMS). Furthermore translation services will be implemented to translate the geological and user interface terms to different languages. The services are based on open standards from the OpenGeospatial Consortium and the INSPIRE specifications, but additionally also on standards such as Rest and GeoJSON.

CLOUD COMPUTING

Although the data originates from services and databases installed at the different participating Geological Surveys, cloud computing is used to fulfil basic (non-)functional requirements (c.f. figure 2). Typical non-functional requirements are the performance, availability and scalability. A user of the system may search for occurrences of commodities throughout Europe, e.g. to explore the possibilities to mine rare earth materials. In case all information is available on distributed servers, such a query will have to be executed at every geological survey, resulting in a high risk of low performance. Therefore the data is stored centralised to act as an optimised search index. It also reduces the risk of having actually inaccurate results if local services are down or unreachable.

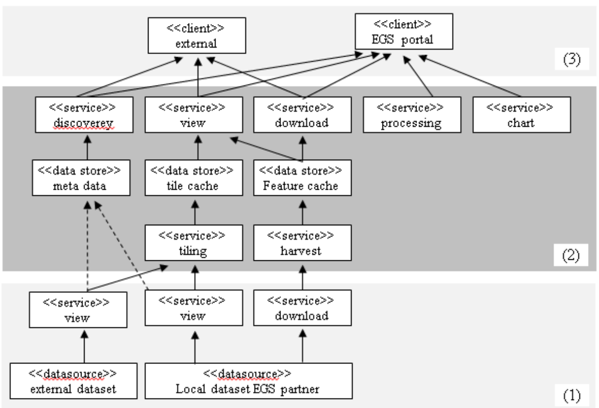

Figure 2 – EGS architecture with (1) data/service provider, (2) central EGS implemented in the cloud and (3) service consumer.

The system also uses cloud computing to compute so called tiles of the WMS services. A typical WMS setup is only able to support a very limited number of concurrent users and requests per second as it creates a map per request. Therefore using a WMS often results in poor usability if many users are accessing the system or if the system is over-requesting the individual WMS. In EGS the creation and caching of tiles is implemented in the cloud (Amazon Elastic Web) giving flexibility to the resources needed to pre-create the tiles and have a dynamic storage size for the tiles. Also the system is automatically scalable if the number of users and requests rises (expected or unexpectedly).

Another reason to (pre-) create and store tiles in the cloud is because other existing map services are used (e.g.OneGeology Europe) that only support the geographical coordinate system ERTS89. While this coordinate system is very useful for exchanging information, it is a very poor coordinate system for portraying geographical maps. EGS uses Spherical Mercator, a projected coordinate system also used by e.g. Google. This leads to much better looking maps. The transformation from maps based on geographical coordinates to tiles based on projected coordinates, is done using cloud computing, as well as the subsequent storing (caching) of the tiles.

The implementation of the EGS system in the cloud ensures satisfactory performance of the system, even for an ANDROID client operating on a 3G network.

PORTAL FUNCTIONALITY

Typically a web portal using spatial information is only visualising the information, either graphically in a map or showing the attribute information per geographical object in a table or pop-up screen. However, contrary to other systems in the case of EGS the emphasis lays not only on making data available, but also on the questions which must be answered by the system and the data. These have been elaborated in use cases and prototypes which have been discussed again with the (potential) users.
This has lead to a user interface where a user can easily “ask” a question that get answered in different ways suiting his needs, including automatically calculated diagrams with aggregated information. The diagrams can quickly show where (in what country) the most potentially rich areas are, what the most common deposit types are, etc. The diagrams are also interacting so a user could quickly zoom to Portugal by clicking in the diagram if he sees there are a lot of potential occurrences there.

REFERENCES

COMMISSION OF THE EUROPEAN COMMUNITIES (2008), The raw materials initiative — meeting our critical needs for growth and jobs in Europe, COM(2008) 699 final

Open Geospatial Consortium Inc (2008)., OGC reference model, OGC 08-062r4 version 2

Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), Official Journal of the European Union, 2007, pp. L108/1 – L108/14.

H. Butler et al (2008), The GeoJSON Format Specification, version 1.0