

## **SIGNA: TAKING ADVANTAGE OF GIS & SDI POSSIBILITIES IN AN INTEGRATED ENVIRONMENT**

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### **ABSTRACT**

Nowadays, thanks to internet, the way of accessing and analysing geographical data is changing and users have a lot of resources within their reach. On the other hand, implementation of INSPIRE has change the way of providing data among Public Administrations. Considering both approaches, the present paper shows the state of the art in IGN Spain, introducing the legal framework, the data and services available on internet and the tools to exploit it in a more efficient manner using standards where is possible.

Data can be downloaded from the Data Download Centre (DDC) mainly for free it they are not for commercial purposes. Later on, the user can analyse it using their own thick client.

Other way of accessing data is to use the geoportal of the National Geographic Information System (SIGNAWEB) that accesses to data using a thin client and also provides all the standard OGC services available at IGN: WMS, WFS, WMTS, CSW, etc. The geoportal also supports GIS analysis combining the best of SDI and GIS fields in only one tool.

Both gates to data, DDC and SIGNAWEB, will hold a prominent position in the new integrated IGN-CNIG website to help the users to access the data easily to be used directly (by mean of download or through SIGNA data base) or indirectly (through standard web services).

### **KEYWORDS**

SDI, GIS, Geographic data, SDI node, IDEE, SIGNA, INSPIRE, LISIGE, OGC, Geospatial Web Services, user interface.

### **1. INTRODUCTION**

In the beginning of the XXI Century we are living the born and development of a new paradigm in the field of cartography: the Spatial Data Infrastructures (SDIs). After having been working with maps, human oriented, and GIS, computer oriented, we are in the position of enjoying SDIs as virtual GIS, fully distributed, implemented on the net by a collaborative community of actors and based on standards and a service oriented architecture.

This new approach is also a consequence of globalization in the field of geographic information.

### **2. LEGISLATIVE FRAMEWORK**

In the last few years there have been a lot of legislative changes regarding geographic data. In Europe the INSPIRE Directive has open a new way of working with GI, forcing the member states to adapt their legislative and technological framework to the new context. Moreover, it has some specific characteristics, on one hand the source of movement is the legal framework and on the other hand the main actors supporting and leading this new deal are the people working in the public sector.

#### **INSPIRE**

INSPIRE entered in force in May 2007, in order to establishing an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment.

INSPIRE is based on the infrastructures for spatial information established and operated by the 27 Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules. This makes INSPIRE a unique example of a legislative “regional” approach.

To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and transboundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting). These IRs are adopted as Commission Decisions or Regulations, and are binding in their entirety. The Commission is assisted in the process of adopting such rules by a regulatory committee composed of representatives of the Member States and chaired by a representative of the Commission (this is known as the Comitology procedure).

#### **NEW GEOGRAPHIC DATA POLICY**

In Spain there was an immediate reaction in NMA's data policies, for example, the Ministry of Public Works approved a new legal text, to adapt the spreading, distribution and licensing of geographic data from the National Geographic Institute of Spain. The Ministerial Order FOM number 956/2008 separates IGN cartographic data in two categories:

1) The National Reference Geographic Equipment (EGRN) that consists of: geodetic and levelling networks, the cartographic grids; the Basic Geographic Gazetteer, the Administrative Boundaries and the National Municipalities Geographic References Inventory.

2) The rest of the geographic products.

Data from category 1 and metadata can be used freely and without signing any licence (CC:by), the only thing needed it to mention the owner (IGN), however, data from category 2 and geographic information services need a licence that can be: commercial or non-commercial, depending on the final use. If the licence is not commercial, geographic data can be downloaded for free.

In case of distributing the data in magnetic format (CD, DVD, hard disk, etc.) the Ministerial Order allows charging a marginal cost due to the value of the media and the work of making the digital copy.

Regarding the Mapping Agencies of Regional Governments, data policy are quite different from the very open ones (CC: by) to very strict commercialization under copyright. Anyhow, there is a general consensus around IGN's collaborative production projects involving several data producers.

### **LISIGE**

The transposition of INSPIRE European directive to Spanish law is called LISIGE (14/2010) that stands for "Law about Infrastructures and Services about Geographic Information in Spain". The scope of the law is setting up some definitions of the new concepts, creating new projects and defining the responsibilities over them.

The reason for developing this law is to establish a common legal frame in which all the existing Spatial Data Infrastructures of Spain could be adapted using standard protocols and specifications.

Chapter II of the law defines what the Spanish Geographic Information Infrastructure is. Furthermore, the responsibility of the coordination, maintenance, update and development of it is given to the Superior Geographic Council (CSG), which is the collegiate body coordinating all the mapping agencies producing geographic data. The resulting implementation is the Spatial Data Infrastructure of Spain (IDEE) [www.idee.es](http://www.idee.es), being the National Geographic Institute (IGN) the technical responsible, holding also the secretariat of the CSG.

Chapter IV defines the General State Administration Geographic Information Infrastructure. This is similar, regarding responsibilities, to the Spanish Geographic Infrastructure. The implementation of this new figure is IDEAGE [www.ideage.es](http://www.ideage.es).

The law defines an SDI node as the set of interoperable services of geographic information accessible through internet, by an organ, organism or entity belonging to Public Administration. It also defines geoportals as the web site or equivalent that provides access to interoperable services of geographic information that belongs to several organs, organisms or entities, which also includes at least one service for searching data and other accessible services.

### **3. SPANISH NSDI AND COLLABORATIVE PROJECTS**

IGN is the National Mapping Agency of Spain, having also a wide range of attributions and responsibilities in several scientific fields such as astronomy, geophysics, geodesy and cartography. The present paper presents only some of the projects in which it is involved, some of them collaborative.

First, the projects born to attend the INSPIRE principles before the approval of the Directive are the following:

- IDEE: The Spanish Geographic Information Infrastructure ([www.idee.es](http://www.idee.es)), opened in 2004, is built upon the contribution of a wide community of actors from academia, public and private sector, growing and cooperating for more than eight years. It is based on national resources and the existing Regional SDI's. Nowadays, it's accurately defined by law (LISIGE) and it can be considered a mature and consistent collective project, fully distributed and supported mainly by the National, Regional and Local Spanish governments with a global spirit, having a seven-language interface. Moreover, a set of eleven different type of services following OGC specifications, ISO standards and INSPIRE principles has been implemented and are visible in the national geo-portal: WMS, WMTS, CSW, Gaz, WFS, WCS, WMC, SLD, WCTS, WPS and FTP. The IDEE viewer allows access to more than 1,000 Web Map Services with more than 15,000 layers from more than 500 different nodes, covering all themes in INSPIRE Annexes I and II and some of the themes from Annex III. In addition, some analysis applications and other web

services are available including some tiled WMTS and WMS-C (according to OSGEO WMS-C proposal) and some SOAP services.

From the organizational point of view, all that activity is coordinated by the IDEE Working Group, established in 2002 by the National Geographic High Council (“Consejo Superior Geográfico”). This WG has more than 300 individual members from more than 120 organizations from different government levels, private sector (more than 40 companies) and academia (more than ten universities); it holds three meetings per year and one annual SDI Workshop and it works in two main lines of activity: sharing experiences, new developments and good practices; and producing recommendations by consensus about how to implement and develop standard resources in Spain. Recently it has been opened to neighbour countries: Portugal, Andorra and France.

- IDEAGE: This geoportal is the access point through Internet to the Geographic Information Infrastructure of the whole General State Administration. IDEAGE is conceived mainly as an SDI geoportal, grouping a set of services. The main aim is the Management of the infrastructure and development of it, across encouraging “SDI culture” among the bodies of the Administrative institution of the central government.

IGN also participates in other collaborative projects. The common feature of all of them is that are based on collaborative cartographic production and the reuse of existing services. Some of the more relevant are:

- CartoCiudad, a street and road database based on the harmonization of geographic data from Spanish Cadastre, National Statistic Institute, Mail Authority and IGN Spain. The information is available on the net via WMS, WMTS, WFS, FTP and WPS services.

- PNOA (National Plan of Aerial Orthophotography) covering the whole Spanish Territory every 2 years with a 25/50 cm resolution under the umbrella of a set of collaboration agreements between National And Regional governments. The final orthophotos are available also by means of WMS, WMTS and FTP standard services.

- SIOSE (Spanish Land Cover and Use Information System), a multipart collaborative project, involving 6 Ministries and Regional governments to produce a 1:25,000 database describing land cover and use information.

Last, but not least, these available services are exploited by other projects, most of them mash-ups, which are closer to final applications and requirements, for example:

- Petrol station geoportal by Spanish Ministry of Industry, Tourism and Trade, showing all the petrol station of the country as Point of Interest on IGN WMS, allowing also to search the cheapest station of the selected fuel type.

- Goolzoom, a mash-up showing Google Maps cartography and most of the available Web Map Services from IDEE in an integrated viewer for real state purposes.

- Anthos, flower and plants species distribution (more than 1 M species) portal using public Web Map Services as cartographic reference, maintained from 1999 by the Royal Botanic Garden of Madrid.

#### **4. USER'S RESOURCES**

In the last few years projects and services have grown so fast that there is a need of explaining it to the users showing the actual possibilities available in the GIS and SDI world that are as well complementary and easy to use.

Considering that there are two kind of potential users there are different user requirements. The first one are the non-expert users that need to see the data without any configurations, without installing any plug-in, with the possibility of loading data in an easy way and also doing some simple analysis of the data but the obvious limitations of an usable thin client. The other kind are the expert users that need reliable data and services, easy access to datasets download and the possibility of making complex queries, regardless if they have to install a plug-in or even work in their own desktop client (thick client)

This situation led us to develop two solutions. Note that both can be used by both kinds of users, this is just a theoretical simplification.

- Standard services (WMS, WFS and others) and the Download Data Centre (DDC) of CNIG are oriented to expert users that can connect to services from their own desktop GIS adding the downloaded data.

- SIGNA is focused on a non expert user that will be able to connect to services and download data without any knowledge about SDIs. SIGNA has also some utilities for experts to exploit services efficiently. Therefore, SIGNA is an efficient online Geographic Information System that gathers all the IGN information provided by standard web services and also by direct connection to its database, which contains lots of vector and raster information produced in IGN Spain.

## **CNIG DATA DOWNLOAD CENTRE**

A first beta version of the Data Download Centre (DDC) of CNIG Spain has been opened to the public in 2010 to give the users an usable and easy interface for downloading the geographic data in an efficient way.

CNIG DDC allows the user to download the geographic data and metadata selected, using a FTP protocol after accepting the corresponding licence. The geographic data are distributed in standard de facto formats, as ecw, shp and zip in order to make it easier. Metadata are available in XML format.

In this version of the DDC the following products are available, among others:

- ortophotos from the National Plan of Aerial Orthophotography (PNOA) in two releases: Maximum Up-to-dateness (MA) and Maximum Resolution (MR),
- the street and road map official database of Spain from CartoCiudad project,
- the Digital Topographic Database 1:25.000 (BTN25) that is the vector data base covering whole Spain
- and the National Geographic Reference Equipment (EGRN).

The system has a multilingual interface and it is compatible with the more extended web browsers (Internet Explorer, Mozilla Firefox, Google Chrome).

The process of searching, selecting and downloading data can be summarised in three main steps:

- 1) First, the user has to define the area of interest that contain the data to be downloaded, this selection can be done using different criteria: selecting a National Topographic Map tile; an administrative unit; introducing the coordinates of a bounding box; or selecting a point of interest clicking on a map or searching a geographical name in the gazetteer.
- 2) Second, the application returns a list with the available products and data in the area of interest, showing a short description (name, format, size, metadata associated file...) of the data files. Then the user can select a data product or get information about all of them.
- 3) Finally, after selecting a unit to be downloaded, the user has to accept the licence (it doesn't apply to EGRN) and then the download starts.

From our personal point of view, this project constitutes a remarkable contribution to facilitate and promote the usage of geographic data and it makes IGN Spain one of the first National Mapping Agencies distributing part of their products for free, giving access to the rest in quite open conditions.

### **THIN CLIENT- SIGNA**

The National Mapping Agencies have the assignment of producing and updating geographical data in a coordinated way, in order to make them able to be analyzed by Geographic Information Systems (GIS), they have also to publish standard web services, to produce analogical cartography, and to prepare data for being downloaded and used by users.

IGN got his first development in GIS field in 1976 as a pioneering prototype. A second version of the project was developed in the 80's at 1:200,000 scale and it was based on a conventional relational DB and a CAD interface to show vector data, but the GIS state of the art at this time limited its functionality.

In 2003, IGN Spain started the preliminary studies for developing an essential and strategic project which consisted in the implementation of a corporative Geographic Information System (GIS) with the target of fulfilling three fundamental objectives:

- a. To manage geographical and cartographical data in an integrated system.
- b. To publish these data in digital format and in a normalized way in order to analyse and query it from thin and thick clients.
- c. To develop a specific client accessible through a simple web browser; versatile, interoperable and efficient.

In this context the modern version of the National Geographic Information System of Spain (SIGNA) was born. SIGNA is a multiscale and seamless vector GIS, which is completed with all the raster imagery available in the institution. All this system should also be analyzed by local and remote clients.

The first release of this viewer was developed in 2004, and it was made with the best technology available in that moment. Nowadays times have changed and forced us to update it, developing a more powerful viewer with GIS analysis possibilities and adapted to the current legislative context due to INSPIRE and the transposition of it to the Spanish legislative frame; LISIGE, the "Law about Infrastructures and Services about Geographic information in Spain"

Therefore this system forms the basic tool for the analysis and exploitation of geographical data produced in IGN, using also interoperable and normalized web services, complimented when is necessary with client functionalities and non standard solutions.

The project is composed of two workgroups; Structuring (Estructuración), which deals with creating a seamless database feature oriented, and the part which deals with the development and maintenance of the interface to access these data, the geo-portal SIGNAWEB.

Everything is focused on the perspective of an official reference geographic data producer, and a service provider based on that data, following the guidelines drawn by INSPIRE and LISIGE legal framework, implementing ISO 19100 series and Open Geospatial Consortium (OGC) standards and Spanish Spatial Data Infrastructure Working Group (GTIDEE) recommendations.

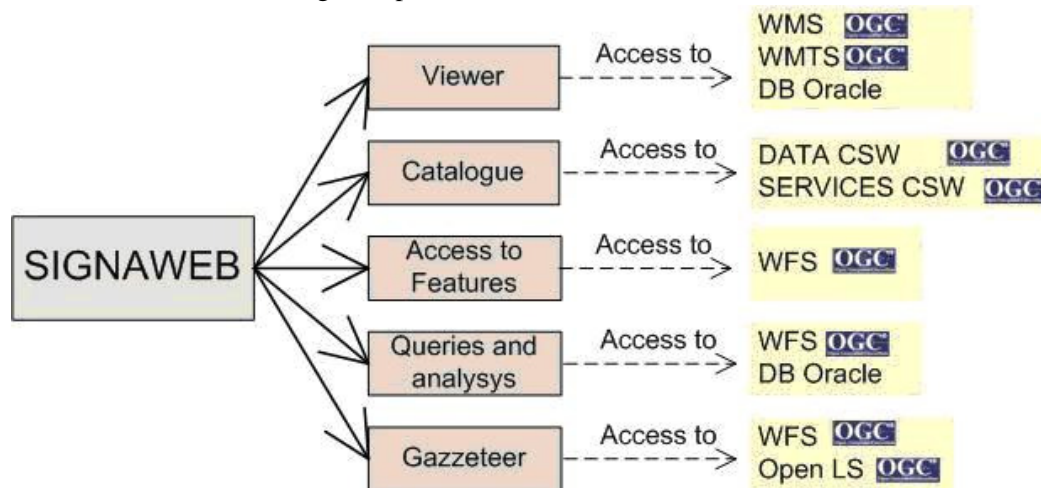


Figure 1: Content of SIGNAWEB and path to access data

### Data and web services available in SIGNAWEB

SIGNAWEB is the geoportal which accesses to several OGC services such as WMS, WFS, WMTS, CSW, etc. and also to several non standard services, in order to improve the performance of GIS queries to his own database.

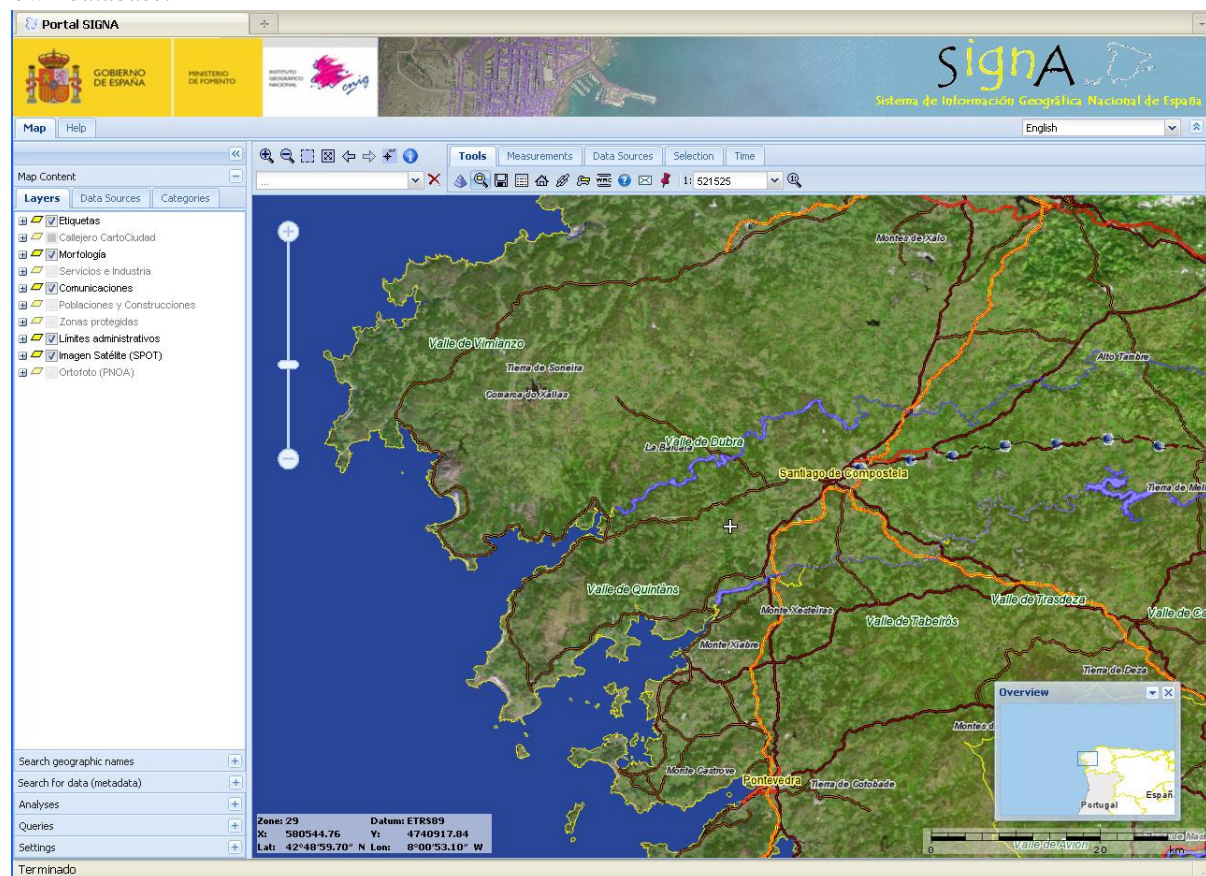


Figure 2: SIGNAWEB screenshot

## **Database**

SIGNA's database is composed by geographic and alphanumeric data from several existing projects in IGN. Currently the global scale of data is about 1/200000, but there are also some exceptions that allows a good cartographic representation at larger scales. Data are selected and processed in order to generate geographical features with a collection of attributes of interest to be analysed by users.

The information has been organized following a classification of 8 themes as has been used in the cartographic databases of IGN during the latest decades:

- 01: Boundaries
- 02: Relief
- 03: Hydrograph
- 04: Vegetation
- 05: Constructions
- 06: Transport Infrastructures
- 07: Pipes and distribution
- 08: Geographic Names

Information has been taken from many different projects:

- BCN200: Cartographic numeric database at 1/200,000scale: 33 entity classes edited and adapted to web GIS analysis.
- Euro Regional Map (ERM): The Eurogeographics geographic database, originally made from BCN200 but currently adapted to ERM general scale: 1/250,000 and ERM data model.
- ANE (National Atlas of Spain), SIOSE (Geographic Information System about Land Cover) and CORINE Land Cover
- PNOA (National Plan of Aerial Ortophotogrammetry of Spain) and Spot providing aerial and remote sensors imagery.

Therefore, SIGNAWEB is composed by a set of 66 entity classes selected from many different projects.

The connection between the client and the database is direct, what helps to manage the data processing in a more efficient way than using Web Feature Services (WFS). Although, the access, analyse and download of data using WFS is also allowed.

One of the most important advantage of the system is the possibility of analyse data obtained directly from the database or indirectly from a standard web service (WFS), without using any special software, just having internet connection an a common web browser.

## **OGC Services**

IGN produce a big catalogue of services, boosted by INSPIRE European directive and LISIGE Spanish law. This set of services produced by IGN sets up the IGN SDI node, and SIGNAWEB is the geoportal to access it. This characteristic, combined with the capability of data analysis, makes a powerful combination. IGN currently has:

- 20 Web Map Services (WMS) offering, for instance, the Bouguer anomaly data, geodesic data, cartographic data such as the Topographic National Map (MTN), digital elevation models, satellite imagery, etc.
- 7 Web Feature Services (WFS) such as Boundary lines, geodesic points or gazetteer.
- 3 Web Coverage Services (WCS) corresponding with the digital elevation model.
- 1 Web Processing Service (WPS). To exploit the DTM, obtaining the maximum or minimum height of a delimited area, or computing the visibility between two points.
- 2 Catalogue Service Web (CSW) for searching IGN services and data metadata.
- 1 Web Coordinate Transformation Service (WCTS).

The URL of these services is available at:

[http://www.idee.es/CatalogoServicios/CatServ/directorio\\_servicios.html](http://www.idee.es/CatalogoServicios/CatServ/directorio_servicios.html)

SIGNAWEB is connected by default to many of this IGN services, and it also has the capability of connecting any other OGC services in an easy way. Responsibility of maintaining services does not fall in SIGNA project with the exception of its own WMTS created as the base map of the application. In that way, SIGNA has been a pioneer using an implementing this new OGC standard published in April 2010.

A location service based on geographic identifiers has been also developed, using the WFS of CartoCiudad and geographic names from IDEE Gazetteer. This tool is implemented with an Open Location Service (OpenLS) searching in a unique text box where the user can look for addresses, geographic names, urban

areas or municipalities, being the web client who decides the database where it has to search, depending on the structure of the character string.

The geoportal is also connected to IDEE data and services catalogues, developed based on the CSW OGC standard.

### **Functionalities**

The geoportal developed had the following requirements: it had to support OGS standards (OGC, W3C); it had to be developed as a thin client, avoiding the installation of any plug-in, and it had to be stable and reliable over the most common web browsers and in the most common releases of them.

Two main features that help to manage a good performance are: the asynchronous behaviour and the use of map tiled services based on WMTS OGC standard.

The tools available allow a wide range of possibilities:

- Basic utilities. Being important to mention the Web Map Context (WMC) implementation, the Get Feature Info through multiple layers (WMS or WMTS) and the button for hiding the banner and the layer tree area in order to make the map area bigger.
- Guide map. User configurable zoom and interactivity.
- User's feedback. Contact mail for sending comments or queries about the system and another utility for reporting data errors.
- Legend. Is structured following three different criteria and showed in three tags: layers, data sources and category. Is important to mention the possibility of displaying the metadata summary as well as the transparency handler.
- Selection, edition and exportation tools. The result of a query can be exported to shapefile and GML format.
- Working frame configuration. SIGNAWEB has many parameters that the user can configure depending on their needs or likes, such:
  - o The Coordinate Reference System (CRS). The following are available: WGS84, ETRS89 and ED50, in geographic or projected coordinates.
  - o The screen size, in order to give an accurate scale value
  - o The possibility of hiding or showing the graphic scale bar, the zoom bar and horizontal navigation button, the hair cross and the guide map.
- Services. SIGNAWEB is using some web services provided by IGN:
  - o The combined search of addresses and geographic names, using an Open Locator Service (OpenLS).
  - o Seek of IGN products using IGN CSW across the metadata following INSPIRE directive.
  - o Tool for adding standard external services such as CSW, WFS, WMS and WMTS
  - o Tool for adding non standard external services such as – MapPublisher source, printing source, Egis source ...
- Queries. SIGNAWEB allows thematic, spatial and mixed queries using his own database or any WFS. For that, a simple dialogue was designed, trying to provide a usable interface for experts and amateur users.

## **4. FUTURE PLANS**

### **DDC**

DDC future prospects to improve the service and make it more efficient are:

1) Adaptation to the recently approved regulations, developing the implementation of 11/2007Law about citizen's electronic access to public sector services:

- Royal Decree 3/2010 [11], defining the Esquema Nacional de Seguridad (ENS), what means, defining a set of measures to guarantee services, communications, data and systems security in public sector activity.

- Royal Decree 4/2010 [12], regulating the Esquema Nacional de Interoperabilidad (ENI). Its purpose is to create the conditions required to guarantee technical, semantic and organizational interoperability among services and Information Systems implemented by Public Administration.

2) To support a set of standardized formats, as GML, compressed GML and GML in JPEG2000.

3) To make all the digital cartographic products of IGN Spain available, maintaining the performance, availability and capacity of the download services.

4) Monitoring, maintaining and improving of service Quality following INSPIRE regulations, to make CNIG DDC to INSPIRE legal framework, paying special attention to Implementing Rules on Network Services and Download Services [13].

5) To Interoperate with other applications and SDI nodes defining a web service to enter DDC through external applications and viewers, based on a description of the active geographic extent, the scale and WMS services (context) selected by the user in the origin application.

### SIGNA WEB

IGN is on the verge of publishing a new web site integrating the old IGN and CNIG sites, where SIGNA WEB has a privileged role, to be the main viewer of IGN geographical data and also the gate of entrance to the SDI node containing all the OGC services available, using the advantages of combining SDI and GIS technologies.

In order to increase geoportals' functionality, more tools are planned for near future, using standard web services:

- A routing tool using the Web Processing Service (WPS) of Cartociudad, providing the shortest route between two points.

- A terrain analysis using the IDEE Web Processing Service (WPS) that calculates a terrain profile, a visibility map, etc. To implement it is necessary to use the Web Coverage Service (WCS)

To sum up, the aim is to implement every standard web service produced in IGN. For that reason we pay attention to the born, evolution and maturation of OGC standards.

It is also planned to manage improvements in the performance of the queries to do it more efficient, in that way, there is a need to improve and scale the computers infrastructure as well as the database tuning.

There is also a collaboration agreement with the Spanish Land Cover Information System (SIOSE) in order to share general developments and tools for both projects.

### 5. CONCLUSIONS

SIGNA WEB and DDC hold a prominent position in the new IGN-CNIG web site as is shown on the figure bellow.



Figure 3: SIGNA WEB and DDC in the new IGN-CNIG web site. www.ign.es

The opening of the CNIG DDC is a fundamental contribution to put into practice one of the INSPIRE principles, that says that spatial data shall be available for all type of users and applications under conditions that are not restricting its extensive use. It is also aligned with the spirit and philosophy of PSI Directive and Spanish Law about the electronic access of citizens to the public sector services.

DDC is complemented with SIGNAWEB, a geoportal that allows viewing, analysing and downloading of geographic features, using direct access to the database as well as IGN standard services, both combined in a thin client.

Undoubtedly, future releases will tend as much as possible towards OGC standards, but only if they can provide a mature, reliable and efficient solution to user requirements. Otherwise, the solution will be provided by a non standard solution.

Finally, as times are changing and we are now in the position of taking advantage and exploit the benefits and possibilities of the most recent and powerful paradigms in the field of geographic information, combining them freely to obtain the best solutions to satisfy user requirements: Geographic Information Systems and Spatial Data Infrastructures.