

CartoCiudad Web Services: Standard Web Services for the location, routing and navigation on official geographic data in Spain

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Abstract. This paper presents CartoCiudad project as an official thoroughfare network database, supplemented with nationwide urban cartography and census and postal districts, which data are provided by the competent Public Administrations, at both state and autonomous level, coordinated by the National Geographic Institute since 2006. Designed to be exploited through Internet using standard web services, CartoCiudad's GIS topological structure facilitates routing calculation between addresses anywhere in Spain as well as other geoprocesses.

Keywords: *CartoCiudad, databases, web services, WMS, WMS-C, WFS, WPS.*

1. Introduction

CartoCiudad is an official database, with national coverage, of seamless thoroughfare network supplemented with nationwide urban cartography and census and postal districts.

This project, launched in 2006, is the result of harmonization and integration of official digital cartography and data produced by the main suppliers of Geographical Information in Spain: Cadastre, Statistical Office, Post Office and the National Geographic Institute (hereafter IGN) which is the manager organization as well. Public organisations from some Autonomous Regions (Basque Country, Navarre, Valencia, Balearic Islands, La Rioja, Andalusia) take also part in this data flow in order to guaranty the feasible data maintenance and ensure the future sustainability of the project.

The street map CartoCiudad contains urban areas data throughout nationwide which are connected through the Spanish roads network in order to allow the seamless navigation. Besides, the postal codes and ward polygons are also represented.

Data are provided by the following official national stakeholder:

- General Directorate of Cadastre, who takes part in this project through data related to urban background: blocks, urban parcels, building (with different coverage), streets axis, house numbers, toponyms and auxiliary lines as sidewalks.
- Statistical Office (INE) collaborates with census districts and sections polygons, and also, through the database which contains the street official names collected from municipality departments.
- Post Office supplies a database which contains the relationship between every postal address and its corresponding postal code. Polygons are drawn from those data postal code.
- National Geographic Institute (CNIG/IGN) supplies data from Spanish reference cartography to 1:25.000 scale (BTN25), mainly the transport network. Besides, it contributes with the municipality border lines and with the orthophotographies PNOA (National Plan for Airborne Orthophotography) used for the data control and updating (as reference data source). Moreover, CNIG/IGN is the organism in charge of leading and managing CartoCiudad project.

2. Web Services

CartoCiudad has been designed for users to freely access the data via standard web services on the Internet. Available at the CartoCiudad geoportal on www.cartociudad.es, this infrastructure allows users implementing cascading services thus developing new services of added value. So far there have been developed by the IGN three kinds of web services: WMS (Web Map Service) (OGC WMS 2013) and WMS-C (Web Map Service - Cached)) (OGC WMS-C 2013) for visualising, WFS (Web Feature Service)) (OGC WFS 2013) to locate entities (addresses, postcodes, census information, administrative units) and WPS (Web Processing Service)) (OGC WPS 2013) to implement functionalities like routing or reverse geocoding throughout Spain. All the information regarding CartoCiudad data model, metadata and services is published and available in www.cartociudad.es/portal/.

The project's web service infrastructure has been based since its inception on the use of free software. Thus, WMS and WMS-C have been created with GeoServer 2.1 (Geoserver 2013), WFS with Degree 2.4 (Degree 2013) and WPS with 52 North (52 North 2013).

2.1. Web Map Service

According to the OGC WMS Specification (version 1.1.1 and 1.3.0), it allows generating digital maps dynamically. This WMS can be invoked using a browser or the CartoCiudad web client, which allows displaying data and navigate all over territory thanks to basic tools like zoom, pan, distance measure tool, as well as advanced tools linked to WMS operations.

2.2. Web Map Service - Cached

In order to reduce response times CartoCiudad client has generated a cached WMS or WMS tessellation from CartoCiudad above.

2.3. Web Feature Service

According to this functionalities, WFS allows locating postal addresses (thoroughfare name and house number) after specifying municipality and province if it is needed, or locations defined by a road and a kilometric point. It also permits users to locate other entities: postcodes and census districts and sections (wards).

- Locating a postal address: The web client allows users to key the name of the thoroughfare and the house number, as well as the municipality and the province (it is only compulsory to fill the first field) of the address requested. The service returns addresses which satisfy the parameters indicated:
 - Addresses coinciding exactly with the parameters thoroughfare name and house number entered.
 - Addresses containing the word entered to identify the thoroughfare and the house number.
- Locating a postcode: it allows users to locate the postal area from a input postcode.
- Locating a ward: the service allows user to locate these features from the input codes.

2.4. Web Processing Service

CartoCiudad offers two functionalities based on the geoprocesses implemented according to the WPS Specification (version 0.4.0):

- Routes calculation between two points throughout Spain. After entering the addresses of the two points, the service calculates the minimum route between them and provides a description along every stretch of the streets. The web client displays the route on the WMS, being

possible to add waypoints dynamically to change the route calculated previously.

- Proximity calculation that allows asking for the maximum area inside it users can access points of interest (POI). This area can be defined through two kinds of distance: the radius of the searching circle (Euclidean distance) or Manhattan distance (following the geometry of route along the streets).
- Geographical Coordinates Translation to Postal Addresses (GC2PA), i.e. the inverse gazetteer which allows obtaining postal addresses from geographical coordinates through a XML query, being possible to do massive requests introducing more than a pair of coordinates. The response is a XML document with the postal address closest to the given coordinates.

2.5. API web

Another utility of CartoCiudad is a free light web component called *CartoVisor*, which can be embedded in any user web to visualize the cartography and to upload points of interest on it (for instance, a hotel chain can use it to locate its buildings all over Spain). It also allows locating postal addresses and routing throughout Spain. Moreover, the displayer size and language (choosing between Spanish or English) can be customized.

3. Conclusion

The most important conclusions regarding CartoCiudad project can be summed up in the following lines:

- CartoCiudad Project is the result of a collaboration relationship among the three administration levels of Spain, so it means an efficient work flow.
- CartoCiudad shows the capability to harmonise geographic information from different sources to get new uses from the resulting GI.
- The free access to the official CartoCiudad data will promote new services producing an important added value chain of many applications and services with specific performances of public or private interest.

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