

SPANISH CADASTRAL INFORMATION SYSTEM.

Current status and I.T.Renovation Strategy

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SUMMARY

Like other organisations, the General Directorate of Cadastre has made enormous efforts in recent years to computerise the management of cadastral databases and processes, not only to guarantee the availability of a complete and up-to-date data bank but also as a means to improve service quality to citizens, companies and other public entities

These efforts have been weighed down by factors such as the complexity and peculiarities of the Cadastre, the level of technology in the different phases of the process, the diversity of the flow and interchange of information with external agents who collaborate with the Cadastre in the maintenance of cadastral databases; and also, the territorial dispersion of the sources of data, updating of data and customer service procedures.

The conjunction of the foregoing has resulted in the current Cadastral Information System, with its strengths and weaknesses which, like any other live and changing system, is in a constant state of evolution.

The purpose of this paper is to summarise the current Cadastral Information System and to briefly outline future trends.

Introduction

The law establishes that the Real Estate Cadastre is a register describing rural and urban real estates. This description includes physical, legal and economic characteristics, featuring location, cadastral reference, surface, usages, class of crop, buildings, graphic representation, cadastral value and title holders.

It also establishes that Cadastral operations, activity, revision and diffusion are the competency of the General Directorate of Cadastre, either directly or in collaboration with Local authorities, other public entities and the Property Register, and that the Cadastre should organise itself as a database available to citizens and public administrations.

Therefore, the principal tasks or competences of the General Directorate of Cadastre are:

- To perform, or otherwise manage, control and co-ordinate the performance by third parties of, the technical work of creation, conservation and revision

of real estate cadastres.

- To research and co-ordinate real estate assessment systems, coordinate the resulting real estate values, and approve Value Proposals.

- To produce and maintain the cadastral cartography necessary for the creation, conservation, and revision of Real Estate Cadastres.

- To prepare studies and proposals of regulations and systems relative to the tasks of creation, conservation and revision of real estate cadastres.

- To manage and make available the cadastral databases as a public service.

- To carry out real estate studies and to prepare and analyse statistical information contained in real estate cadastres and that relative to real estate taxation.

CADASTRE AND REGISTER IN SPAIN

In Spain, the Cadastre and the Property Register are two independent but closely related organisations.

The General Directorate of Cadastre, dependent on the Finance Ministry, possesses physical and economic data on real estate together with the identification of the cadastral title holder. It also features graphical databases allowing the location and identification of real estates and assignment of a cadastral reference. This is a fiscal cadastre which calculates stores and maintains cadastral values, all in an information system available to the public.

The Property Register depends on the Department of Justice within the Ministry of the Interior, and constitutes a legal register of rights that ensures a high degree of legal security in real estate transactions and also acts as a freely accessible public information service.

While the Cadastre uses the cadastral parcel and urban unit as the basic entity, and cartography as the essential territorial support, the Register stores titles and deeds, registered using regulated systems of registration.

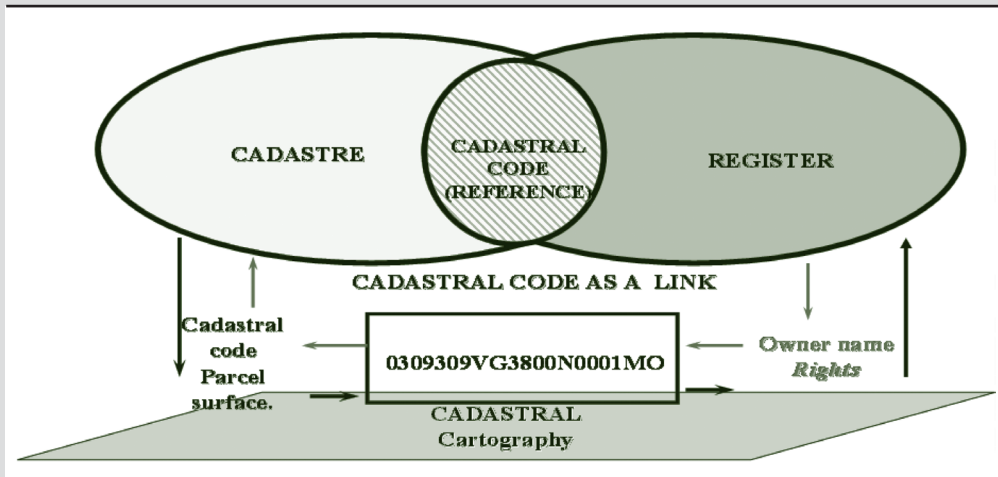
Today, the Cadastre and the Register are related systems which use the same Cadastral reference as the key to identification of real estate, and are working towards using cadastral cartography as a territorial support for the identification, location and description of parcels.

To this effect, in compliance with article 54 of Law 13/1996 dated 30 December, notaries and property registrars must submit to the Territorial Offices of the Cadastre the information relative to the documents they witness or register and which involve cadastral alterations of any kind, specifying whether the parties have duly supplied the cadastral reference.

A BRIEF DESCRIPTION OF THE SPANISH CADASTRAL ORGANISATION

The Spanish territory covers over 500,000 square kilometres. The General Directorate of Cadastre is

Figure 1
Cadastral-Register Coordination; conceptual model



responsible for the cadastral administration of 95% of the territory, and the remaining 5% is administered by the regional governments of Navarre and the Basque Country.

The G.D. of Cadastre, with headquarters in Madrid, has 16 regional offices and 52 local branches. It employs over 2,880 public servants, including 300 in Central Services who work in the coordination, design and implementation of cadastral information systems, which are then exploited, maintained and updated by the local branches.

The G.D. of Cadastre has a budget of 107 million euros for 2003. Almost 5 million euros have been invested in the acquisition of hardware and software and in systems development, not including the salaries of 60 public employees in the Deputy Directorate of Information Systems and of nearly 300 more who exploit the information systems in the local branches.

7,575 local authorities fall within the competency of the G.D. of Cadastre, which stores and updates the following entities:

- *Urban Cadastre*
 - 12 million urban parcels.
 - 32 million buildings.
 - 28 million urban units.
 - 1,000,000 Has mapped to scales 1/1.000 y 1/500.
- *Rural Cadastre*
 - 44 million rural parcels
 - 57 million sub-parcels
 - 8 million owners
 - 46,000,000 Has mapped to scale 1:5.000.

The parcel is defined as the portion of land delimited by a closed line, owned by a single individual or by several. Urban units are different properties owned by a single individual and registered individually in the Property Register, and the in the

case of the rural cadastre, sub-parcels are portions of land with different crops, usage or yield.

The Spanish Cadastre is principally a fiscal cadastre, whose databases of cadastral values of rural and urban real estate are the basis for the calculation of real estate tax and other local, regional and national taxes. But this is not its only purpose: it is also a territorial database allowing the location and identification of cadastral parcels and the assignment of the cadastral reference, as well as the supply of graphic and literal information to other public entities.

The foregoing shows that the Cadastral Information System is a dynamic, open system with numerous flows of interchange of information with multiple external agents who interact with the Cadastre's databases both as suppliers of information and as users and clients.

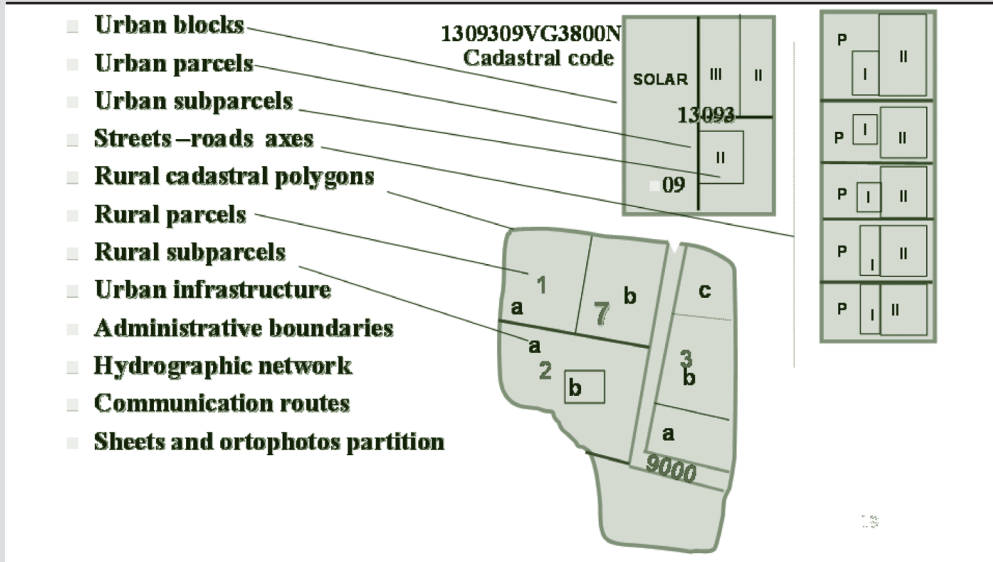
Information is exchanged regularly with local authorities, notaries and property registrars, data is submitted and cross-referenced with other state administrations, and more than 2 million citizens visit the cadastral offices every year.

THE CADASTRAL DATA MODEL AND TYPES OF INFORMATION

As a real estate register, the Cadastre distinguishes between two basic types of properties, based on the type of land on which they are located and the applicable assessment model: these are urban real estate and rural real estate. A third residual category exists for special real estates, whose characteristics require different treatment, especially with regard to assessment (motorways, airports, nuclear plants, etc.).

Two types of description are applied to both urban and rural real estate: a graphic description on cadastral maps, and a literal or alpha-numerical description.

Figure 3
Graphic Entities in the Cadastral Information System



Digital orthophotographs in raster format

As well as the vectorial format, in recent years the system has incorporated digital orthophotography to scale 1:5000 and 1:2000 for rural land.

Orthophotography combines the precision of a scale map with the wealth of information that a photograph can offer.

Digital orthophotographs in black and white or in colour are available for towns updated in the last three years. Resolution varies between 0,25 and 1 metre, although the current trend is to use 0,50m resolution.

Internally, orthophotographic information is stored on files acquired with Mr-SID, and the exchange format is geo-referenced (TIFF+ Twg).

Distribution sketches of buildings by floor; digital CU-1

The CU-1 document is a scaled graphic representation of the properties forming an urban estate.

Cadastral cartography only represents cadastral parcels or urban estates, while the breakdown of floors and interior spaces is represented on CU.1. CU.1 documents are available for those towns with assessment by property, and only part are in digital format.

These documents are stored using SIGCA2 and link up to parcel data by means of the cadastral reference.

Alpha-numerical information

The alpha-numerical information necessary for cadastral management is stored on ORACLE tables. This system stores information on title holders who may possess one or several rural or urban properties. In the case of urban land, urban units are grouped into parcels located on precincts of land with different assessments, containing buildings and urban units. In the case of rural real estate, the unit of property is the parcel, containing one or more sub-parcels assessed depending on crop, use or yield.

The assessment of urban units is performed based on the value of the land and the value of the building. In the case of rural parcels, the value of the parcel is the sum of the values of the sub-parcels it contains.

The link between alpha-numerical information and graphic data is achieved using the cadastral reference.

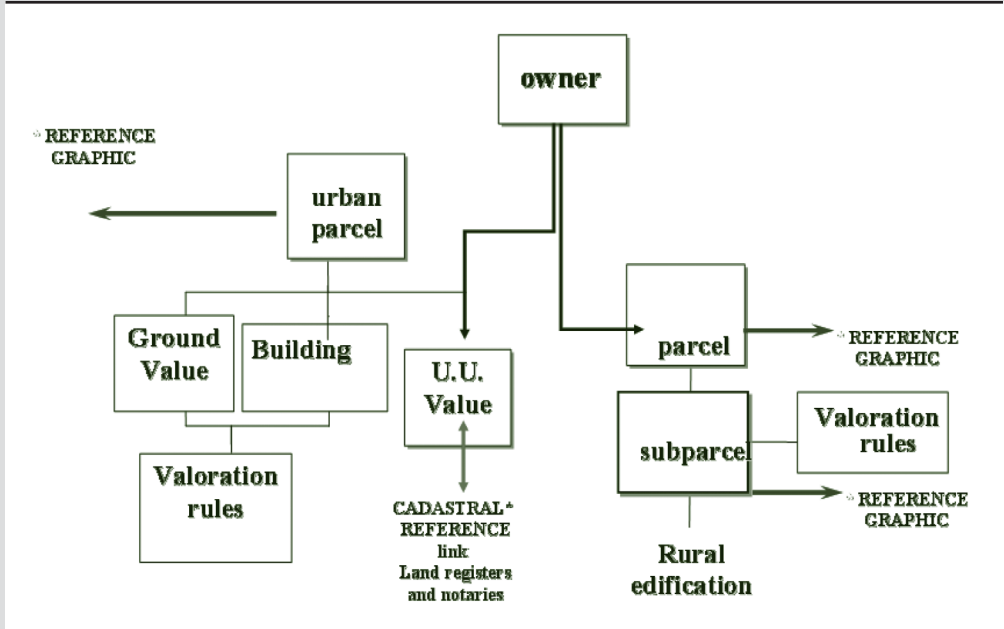
The following figure illustrates the entities described:

The Cadastre's web page www.catastro.minhac.es and the page on the Permanent Committee on Cadastre www.eusrocadaestre.org both contain a description of available information in the section dedicated to cadastral products.

THE CADASTRAL INFORMATION SYSTEM: IMPLEMENTATION CALENDAR, ACHIEVEMENTS AND WEAKNESSES

The cadastral information system is composed of the following sub-systems:

Figure 4
Conceptual data model



Cadastral Management System (SIGECA)

Operational in the 52 local branches of the Cadastre, this system automates all cadastral processes and transactions, from the initial registration of a document, query or application presented at the local branch, to the issue of cadastral certificates and documents.

It facilitates the updating and assessment of real estate, the issue of census lists with amounts payable in Real Estate Tax, mass assessment, etc.

The databases that sustain this system are housed on UNIX departmental servers stored on ORACLE tables.

Cadastral geographic information system (SIGCA)

A Geographic Information System (GIS) that allows loading, filtering, visualisation, administration and updating of rural and urban cadastral cartography. It allows the location, identification, assignment of the cadastral reference and surface calculation of rural parcels and sub-parcels and of urban parcels and buildings.

It also allows the plotting of thematic maps and cadastral maps and includes tools for updating cadastral cartography.

SIGCA is operational in the 52 local branches and stored on the same departmental servers and ORACLE databases as SIGECA

National Cadastral Database (BDNC)

A nation-wide system containing basic data on real estate and cadastral title holders, consolidated for the entire country.

The system allows aggregate consultation and statistical analysis and offers information on the properties of an individual all over the country, and the exchange of national-level information with external agents. Cadastral information supplied on Internet is based on a replica of this database. It currently only features literal information, but next year cadastral cartography will be incorporated.

BDNC is stored on a UNIX-ORACLE server, in cluster, located at the Cadastre's headquarters.

The systems described above are dedicated to the computerisation of all the Cadastre's administration and procedures. The main users are the Cadastre's own employees. Local authorities and other public administrations that collaborate or require information from the G.D. of Cadastre connect via modem or router to the Cadastral Management System (SIGECA).

Virtual Office of the Cadastre (OVC)

Cadastral services on Internet, destined to the supply and exchange of information with cadastral title holders and other external agents who share competencies of cadastral administration (notaries

and property registrars, local authorities and other public entities).

This system is described later.

We will now briefly describe the evolution of the Cadastral Information System, highlighting the achievements and weakness of the system in each phase. If we analyse this evolution we will see three distinct phases:

- Design of the data model, data collection and uploading .
- Data consolidation, graphical and literal information accessible to the entire organisation.
- Cadastral Virtual Office. The Cadastre in Internet.

PHASE 1. DESIGN OF THE DATA MODEL, DATA COLLECTION AND UPLOADING (1990-1998)

The design of today's Cadastral Information System began in the early 90s. Important decisions were made at this time, such as the incorporation of graphic, as well as literal, information into the cadastral databases. The principal cadastral entities and associated attributes were identified, and graphic and alpha-numeric data models were designed.

With regard to available cadastral cartography, the principal entities to be administered and their attributes were identified, a topological vectorial information storage model was developed, and an ASCII format designed for the exchange of computerised cadastral cartography (FICC format) for the exchange of graphic materials.

Also during this period, the literal information from all the local branch databases was uploaded. The data model was oriented to the appraisal of real estate as a taxable base of Real Estate Tax. It is therefore a taxation model and computerisation of all procedures of cadastral administration was initiated.

In parallel, the digitalisation of cadastral cartography was initiated by external companies and uploaded onto the first graphic information libraries.

Literal information was initially loaded onto RDBMS DDBB4 and Siemens-Nixdorf equipment, and later to Unix-HP-UX with ORACLE as database manager. Graphic information was loaded onto ARC-INFO libraries, by town, on Unix work stations. All literal information is accessible on LAN.

The system was heavily distributed and presented the following weaknesses:

- Consolidation of information between different local branches does not exist, and on occasion a single owner is identified differently on different local branch databases.
- Linkage problems between graphic and literal entities on different databases (ORACLE and Arc-Info coverage).
- A continuous map does not exist, generating continuity problems between neighbouring towns with information in different libraries.

PHASE 2. DATA CONSOLIDATION, GRAPHIC AND LITERAL INFORMATION ACCESSIBLE TO THE WHOLE ORGANISATION (1998 – 2001)

Towards the end of the 90s a new Geographic Cadastral Information System was developed (SIGCA 2), a client-server system allowing access from any PC to all graphic information stored on Oracle tables.

A single departmental server and a single database per local branch stores all graphic information. Internal users access graphic information from PCs using the SIGCA2 application, and literal information using VT200 emulation mode.

This new scenario offers the following advantages:

- Cadastral cartography becomes accessible to all local branch users, who access both graphic and literal information from the same terminal.

- All local branch cartography is located on a single table, allowing administration as if it were a continuous map, for both urban and rural land in a single town and between neighbouring towns.

- It allows direct linkage between graphic and literal entities stored on tables on the same database using the cadastral reference

- All cadastral information is accessible on LAN

The National Cadastral Database was also developed at this time, with basic data on title holders and real estate allowing access to consolidated national data through the Cadastre's corporate network (WAN).

The model presented the following weaknesses:

- Although accessible to all internal users, it is not directly accessible to external users and agents collaborating in cadastral administration.
- Users have access via LAN to information on their own province, and via WAN only to basic literal information, since BDNC has not yet centralised all the graphic information.
- Local authorities and public administrations accessing cadastral databases directly do so via router, with the problems of security and administration that this causes.
- The massive exchange of information with external agents is done on exchange formats such as diskettes and magnetic tape.

PHASE 3. VIRTUAL OFFICE OF THE CADASTRE. THE CADASTRE IN INTERNET

The Ensenad@ project is an automated territorial information service, with access, via Internet, to cadastral services and to easily available territorial databases.

This service is destined to citizens and companies, local authorities, public administration, notaries, property registers, and the justice administration. The estimated duration of the project is 6 years (2000 – 2006) and is financed with E.U. funds and the budgeted of the G.D. of Cadastre.

The strategy consists of the development and implementation of cadastral web services as the preferred channel for the performance of the organisation's functions, which will allow:

Figure 5
Configuration of a typical local branch office

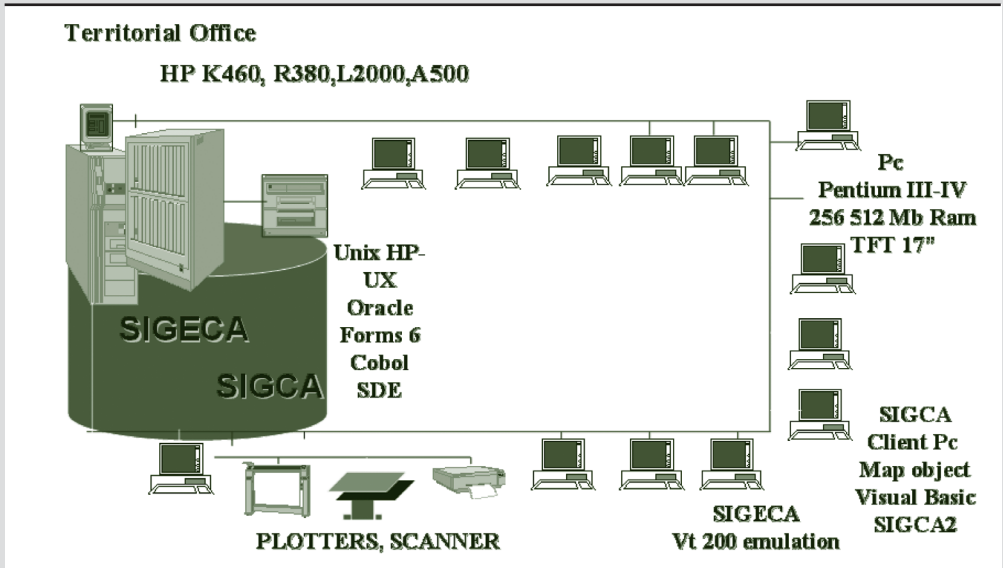


Figure 6
Logical and physical platforms of the subsystems

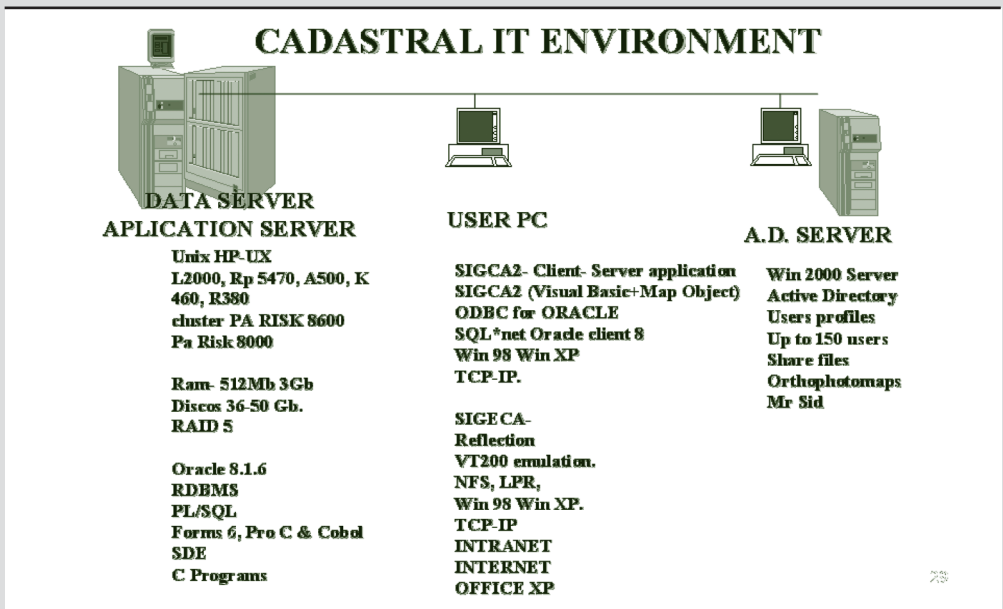
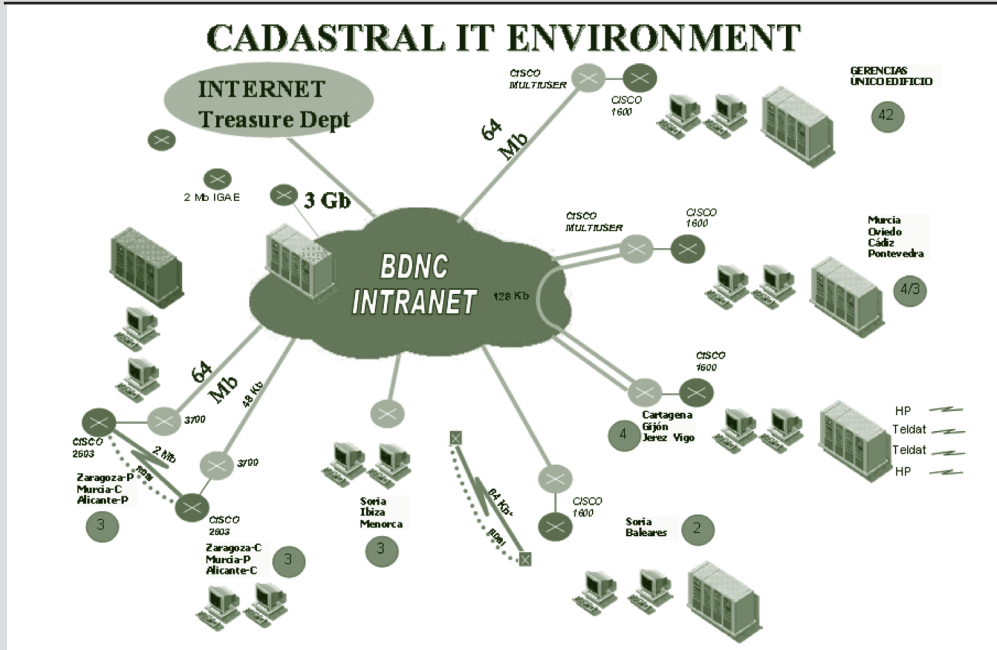


Figure 7
Telematic links between local branches and Central Services



- Connectivity – creating data exchange mechanisms to allow the electronic introduction and transfer of data.
- Accessibility: on-line consultation of cadastral data by all interested parties.
- Personalisation – citizens and Administrations see and act according to their particular role. For this reason, three distinct profiles have been developed:

- Administrations and public entities who access the territory for which they are responsible.
- Private users and citizens who access personal data using electronic signature (PKI).
- Unlimited access to non-personal non-restricted data.

The project phases are described below:

1. Cadastre web page: 1999 – 2002

www.catastro.minhac.es

Its purpose is to make the cadastral organisation known.

It contains general information on cadastral products and services, regulations, statistics, inter-administrative collaboration, etc.

The web page initially features the following basic services:

- Software for notaries and registrars
- Forms
- Cadastre digital newsletter
- E-mail contact service

PADECA. Automated programme for the preparation of cadastral declarations allowing the end user to complete his/her own declaration, with a pdf print incorporating a mosaic label. This label contains the basic data of the declaration, which can be entered automatically using an optical pen.

2 The Virtual Office of the Cadastre: 2003 – 2004

ovc.catastro.minhac.es

The objective during this phase is to provide electronic services to citizens and public institutions, by means of accessibility and connectivity to cadastral databases and services.

Services incorporated are the following:

- Consultation and certification of alpha-numerical cadastral data for individuals (G2C), Administrations and Institutions (G2G). This service is now available.
- Exchange platform for cadastral data files (G2G)
- Cadastre map viewer and application for descriptive and graphic certificates (G2C). This service will be operational soon.

3. *Advanced electronic services: 2005 – 2006*

The objective during this phase is to provide value added services incorporating advanced electronic certification mechanisms (G2C) such as:

- Sale of cadastral products.
- Electronic payment of cadastral duties.
- Correction of personal data.
- On-line presentation of application forms and documents.
- Case monitoring.
- Appointment scheduling for personal visits to offices of the Cadastre.

The *logical and physical platforms* that sustain these services are the following:

- Hw platform:
 - External area (DMZ)
 - 2 IIS servers with Windows 2000 Advanced Server, NLB (Network Load Balanced).
 - 2 Exchange Front-end servers to access to Exchange DB with NLB. (W2K AS.)
- Internal area
 - 2 Exchange DB servers in cluster to manage files repository.(W2K AS)
 - 2 Domain Controller servers (DNS) with active directory to control registered users.
 - 2 SQL server servers (W2K AS) in cluster.
 - 2 Unix servers in cluster with ORACLE for Cadastral db.
 - An S.A.N for data storage.
- Sw Platform:
 - Multilevel architecture:
 - Presentation level
 - Thin client using Web browsers to interpret HTML code given by the Web serve
 - Presentation logical level
 - ASP pages including VB scrip, JavaScript and HTML code, with COM+ (Visula Basic) components
 - Application logical level.
 - SW components to conform the logical of the business.
 - Data access level.
 - Components to data access, to insert, modify or data erase.
 - Data level
 - Services related with the DDBB, cadastral data in Oracle, application data in SQL Server.
 - Veritas Sw as back up manager.
 - Hp-OpenView to manage and control hw and services.

The cadastral information system is an open system which, as we have seen previously, exchanges information with multiple external agents acting as clients, or suppliers of information, and sometimes as both. The new strategy allows direct access to cadastral services via Internet and will produce a progressive reduction in the number of citizens who visit local cadastral branch offices, prevent direct connections via

modem by other public administrations to our databases, and speed up the process of maintenance and supply of information, thus optimising the use of available resources.

The new scenario has given rise to an increasing centralisation of distributed databases into a consolidated national database, using a replica as the Internet data server. The following two figures show the change in the flow of information generated by the Virtual Office of the Cadastre.

STRATEGIES FOR THE FUTURE

Having analysed the evolution of the Cadastral Information System in Spain and the services to be incorporated in the next three years, it only remains to briefly outline the strategic objectives of the organisation in the context of information systems, which should be accompanied by a series of strategic actions. The achievement of these strategic objectives and actions should likewise be accompanied by a series of I.T. objectives and actions which in many cases coincide with those described previously.

Strategic objectives:

- Supply the largest possible quantity of information to external agents. Not just literal information, but the possibility of accessing computerised cadastral cartography.
- Prevent the need for citizens to visit cadastral offices.
- Satisfy the information requirements of clients/citizens and public administrations.
- Guarantee not just availability, but also up to date information.
- Integrity and consistency between:
 - Graphic and alpha-numeric information
 - Owners in all local branches.
 - Continuous mapping for all towns, between neighbouring towns, and between rural and urban land.

Strategic actions for renovation:

- Incorporate information into the OVC.
- Incorporate services into the OVC.
- Customer information and service:
 - In person at our offices.
 - Via Internet and e-mail.
 - By telephone via the Cadastre direct line 902 37 36 35.
- Improve the updating of data via Internet.
 - Using Internet and user accounts for the exchange, validation and incorporation into our databases of exchange files with public agencies that collaborate in cadastral administration.
 - Facilitating the viewing of graphic information
 - Supplying vectorial information on which to directly incorporate graphic updates.
 - Supplying tools to cadastral title holders to allow them to correct their data directly .
- Centralisation and consolidation of data.

Figure 8
Cadastral information system data flows

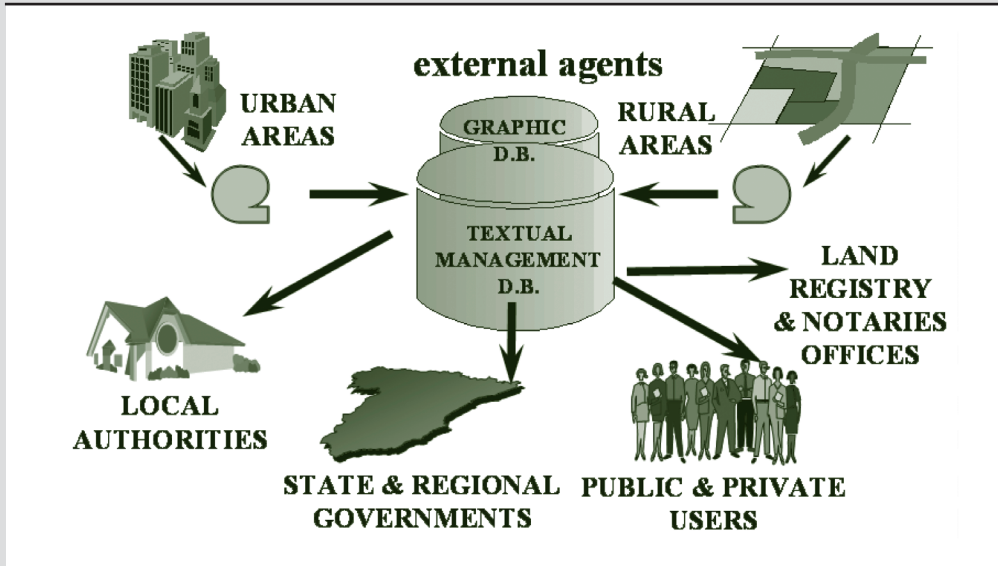
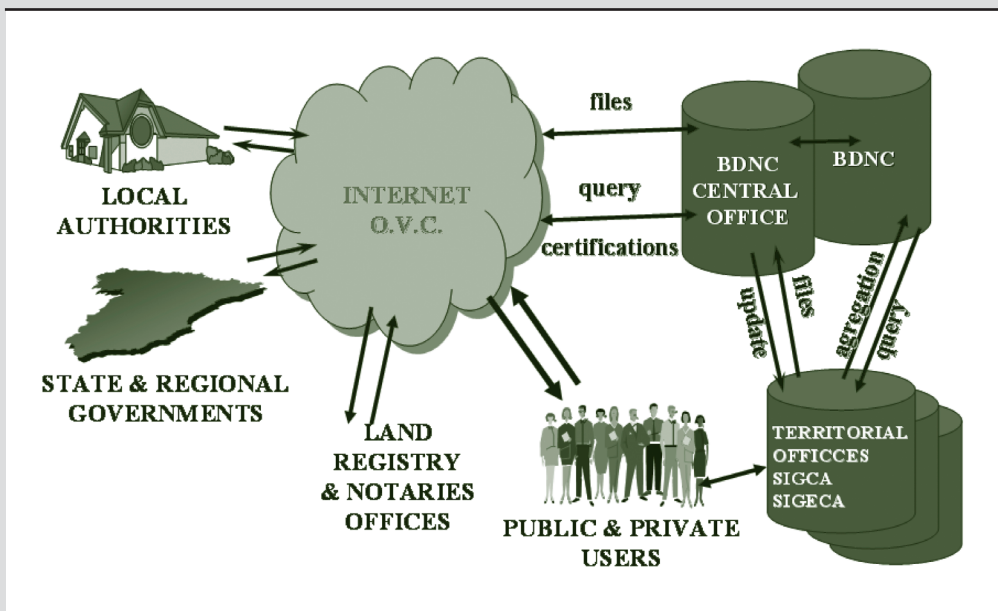


Figure 9
New Cadastral data flows



This requires the achievement of the following objectives and actions in the field of I.T. and electronics:

- Increased information in Internet, not just basic information on real estate and title holders, but also building and urban unit information.
- Incorporation of all graphic information onto Internet.
- Consolidation of the current data model. Have a single, stable and consistent data model for all application environments (SIGECA, SIGCA, BDNC, OVC).
- Progressive centralisation of local branch databases.
- Optimisation of updating actions and processes between local branch databases and the National Database.
- All applications and services, internal and well as external, should operate via Internet/Intranet environments.
- Three-tiered applications with lightweight clients, versatile application environments and robust and stable data servers.
- Incorporation of Metadata in line with European standards and recommendations both for literal and graphic information.
- Interoperability through standards with regard to application environments, exchange formats, etc.