CADASTRAL DATA SERVICES ON INTERNET IN SERBIA

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ABSTRACT:

Pilot project of cadastral data distribution via Internet started at the end of 2001. Reason was a pressure from users who wanted faster and improved access to cadastral data. Motive of the Governmental Geodetic Authority of Serbia (GGA) was to use pilot project for testing technical potentials, but also to use it as a source of experiences for writing regulations that would legally formulate distribution of official cadastral data by using Internet.

Starting assumption for the development of the more advanced solution for data integration and distribution was to respect existing hardware, software and organization of GGA. Large cities were chosen because there were the strongest motives for solving these problems. Also, the best telecommunication infrastructure was there. The proposed solution is based on Internet technology. Software development is based on n-tier architecture. System for data distribution integrated data from different sources (cadastral maps, orthophoto, topographic maps, cadastral register, etc.), different operating systems and applicative software. Software design is based on OpenGIS/TC211 standard (WMS ver 1.0).

Cadastar started as a pilot project in the town of Novi Sad, but during realization it has become an official system for cadastral data distribution. Results that were achieved were: data integration, faster response on user demands, some major municipality agencies has became direct users of new services. Making new regulations of this matter, data acquisition, data quality enhancement, etc followed project realization. Paper describes telecommunication infrastructure of city intranet as an environment for the developed application, application architecture and the data. Some statistics regarding the system exploitation will be also given.

1. CURRENT STATUS

GGA is an institution on a republic level with 155 local offices, 10 regional offices and a central office in Belgrade. A general information system that would encompass all the data operated by GGA has not been developed yet. Data are made, maintained and distributed on a local level, mostly in analog form, and there are no telecommunication links between central, regional and local offices. As far as data are concerned 100% of the cadastral data are in digital form (database), except for the data on cadastral maps that are only 5 to 10% digitized. Another problem is the separation of the data and procedures for handling.

Cadastral maps are maintained by using MapSoft GIS software, and the rest of the data are managed by an old application using FoxPro RDBMS and under Novell network operating system.

2. eCADASTRE SOLUTION FOR NOVI SAD

Starting project assumptions and requirements specified that the designed solution would have to respect current conditions (technical, organizational). All of this has limited number of possible options for the system design. Large cities were chosen because the interest for solving problems related to cadastral data distribution was the biggest there. Also, cadastral offices for these cities were places where data for the whole town territory were already available. Finally, the intranet network was already developed there.

2.1 Chronology

Date	Description
May 2001	*Second MapSoft users conference* – Presentation of the software module MapWorldWide for digital geodetic map (DGP) data distribution
June 2001	Decision of the Government Geodetic Authority (GGA, RGZ) management to start work on regulations and technical standards which should provide legal framework for digital data distribution
July 2001	*Pilot-project 'Technical solution for the DGP and cadastral data distribution of Novi Sad via Internet' proposal made by – MapSoft development team*
Aug. 2001	Completion of the software module CadastWorldWide for land cadastre and real estate cadastre data distribution via Internet/intranet
Sept. 2001	Design and development of the demo version of Internet web site as an illustration of possibilities of distribution of integrated DGP, cadastral and address system data for the town of Novi Sad
Oct. 2001	**Initiative from JP Informatika Novi Sad, major developer of the municipal information system of the town of Novi Sad to get cadastral maps of the town**
Oct. 2001	Proposal of changes and supplements of the '*Bylaw on fees for using state survey and cadastral data and services from Governmental Geodetic Authority'*, which, for the first time, provided legal basis for digital data distribution in practice.
Nov.	Decision of the GGA management to realize

2001	experimental system which is going to provide distribution of cadastral data via Intranet/internet
Jan.-Apr. 2002	Acquisition of data that should enable linking of DGP database and land cadastre and real estate cadastre database managed by local cadastral office of Novi Sad (SKN Novi Sad)
Apr 2002.	Establishment of the connection between cadastral office of Novi Sad and municipal information system of Novi Sad. Implementation and setup of the system for cadastral data distribution via intranet
Apr. 2002	Contract on three-months experimental system exploitation signed between RGZ and Institute for construction of the town of Novi Sad (ZIG Novi Sad)
May 2002	Contract on three-months experimental system exploitation signed between RGZ cadastre and City Planning Department of the town of Kragujevac
July 2002	Setup of the system for distribution of cadastral data via intranet/Internet at cadastral office of Kragujevac. Setup of connection between cadastre and municipality departments
Aug. 2002	'Bylaw on fees for using state survey and cadastral data and services from Government Geodetic Authority' which provides fees for services of data distribution via intranet/Internet published within Official Gazette of Republic of Serbia
Mar. 2003	'Law on Digital Geodetic Map' which considers and regulates DGP data distribution via intranet/Internet published within Official Gazette of Republic of Serbia
May 2003	Contract on commercial exploitation of system for cadastral data distribution signed between RGZ and Public company for city planning of Novi Sad

Used colors	Software develop.	Contacts with customers	Projects	Regula-tions	Data acquisition

Table 1: Chronology of e-Cadastre system development

2.2 Data

DGP data for the cadastral municipality of Veternik, as well as land cadastre and real estate cadastre data for the whole Novi Sad territory were available at the beginning of the project. During the project implementation, data for cadastral municipality Čenej were supplemented. Since there were no DGP data for other cadastral municipalities, team made of six trained surveyors from local and regional cadastral offices has been working for four months on digitalization of parcel numbers. All cadastral maps for the political municipality of Novi Sad were processed. Quality control of acquired data included check of matching parcel table acquired from cadastral maps against the same table from land cadastre (or real estate cadastre if one exists) database.

Project has covered the whole **political municipality of Novi Sad**. Currently, all the data from land cadastre and real estate cadastre databases, DGP data and orthophoto maps for area covered by master map territory of Novi Sad are distributed by using this system. Data structure is as follows (Figure 2):
- Vector data:
  o DGP of cadastral municipalities Veternik and Čenej (more than 200000 DGP points and lines, more than 70000 areas);
  o Digitized points representing parcel position for all parcels for the rest of the territory of political municipality of Novi Sad where there is no DGP data;
- Raster data:

  o Scanned maps for the rest of the territory of political municipality of Novi Sad where there is no DGP data (more than 1000 map sheets);
  o Topographic map TK20 of political municipality of Novi Sad (20 map sheets);
  o Orthophoto maps of Novi Sad - 1:2000 scale (119 map sheets).
- Alpha-numerical data:
  o Real estate cadastre data for political municipality of Novi Sad;
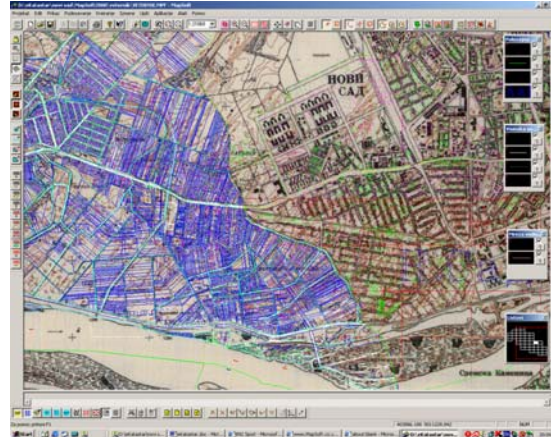 o Land cadastre data for political municipality of Novi Sad.

Figure 2: eKatastar – Novi Sad - combined handling and display of surveying maps of different type

2.3 Communication infrastructure

Local management of Novi Sad has been working on establishment, development and implementation of general information system of the town. Institution responsible for this task was firstly Computer Center of the Institute for city construction, and later, since 1993 it has been JP Informatika. Due to the well organized functioning of the local management, Novi Sad has established communications infrastructure that connects all the important city institutions, as well as their databases (residents, organizations, environment), 10 years ago.
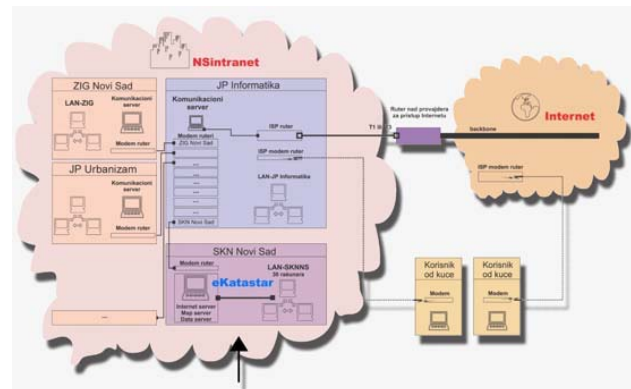

Figure 3: Communications infrastructure

These advantages have been used also for the design and implementation of the solution that should provide distribution of cadastral data via Web. SKN Novi Sad accomplished to get very cost effective and elegant solution of linking to city

intranet. Procurement of two modern routers and leasing of a single 64 kb/s port was enough to connect their office to JP Informatika.

2.4 Software components

Software solution is based on two software components – MapWorldWide and CadastarWorldWide. First of them is part of the MapSoft 2000 software system and it represents Web Map Server which communicates with client according to OpenGIS/TC211 standard (WMS ver.1.0). The other component provide link to cadastral database (land cadastre or real estate cadastre database). System is designed and developed as n-tier application. MapSoft 2000 is used as spatial database server and applicative services are written by using ASP. Together with software applications that provide user administration and statistical analysis of system usage, the whole system is a complete solution that provides simple system administration and usage just by using simple web browser on client side.
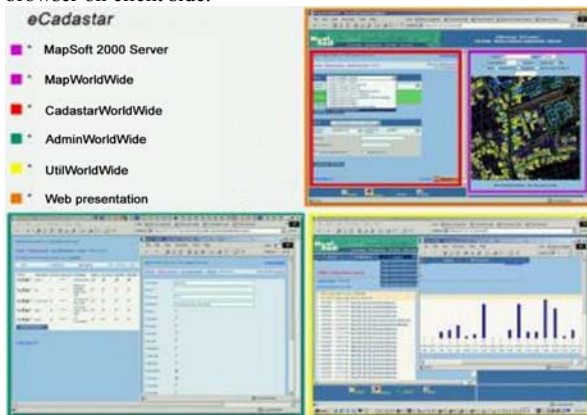

Figure 4: eCadastar: Software components

2.4.1 MapSoft 2000 Server

MapSoft 2000 Server is developed as *ActiveX EXE out-of-process automation server*. MapSoft 2000 application has been developed by using Visual Microsoft software development tools. MFC class library, as industry standard, has been used intensively. Application has been based on *Document/View* architecture. This architecture and fine support to development of *ActiveX* EXE provided by Microsoft's development tools enabled relatively straightforward development of Active EXE server functionality for MapSoft (Figure 4). COM interface has been built for MapSoft's *Document* object. This enabled access to MapSoft's functions from outside, i.e. from other software applications.
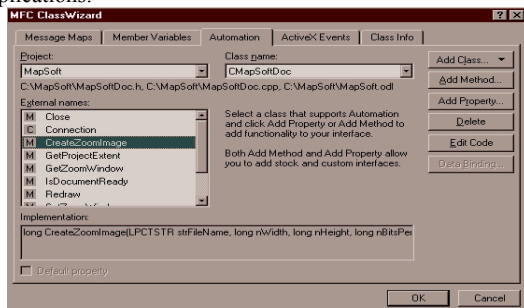

Figure 5: Visual Studio dialog for modifying properties and methods of MapSoft's COM objects (*Document* class *CMapSoftDoc*)

All necessary functions were developed in order to provide the whole solution. The most important functions are the following: *OpenWorkspace, SetActiveWorkspaceProject, CloseWorkspace, GetNumberOfProjects, GetProjectExtent, GetProjectName, GetDefaultProject, SetZoomWindow* (set active windows coordinates), *GetZoomWindow, CreateZoomImage* (creates image file for current window), *IsDocumentReady, WhatIsThis* (returns object from database on specified location), *WhereIsThis* (returns object from database with specified ID *Close* (closes server connection for specified project).

2.4.2 Link to DGP – MapWorldWide

W3Map
Applications *W3Map.asp* i *W3Map.dll* make up application server (IIS application). Application server's task is to 'listen' to demands of Internet users, to process these demands and to forward them to *Data Server* (MapSoft 2000 Server). Also it has to process received answer from *Data Server* and to send it back to the Internet user. *W3Map* implements all three interfaces specified for *Web Map Server*:

- *Capabilties (GetCapabilties)*
- *Map (GetMap)*
- *FeatureInfo (GetFeatureInfo)*

MapWorldWide provides information to the user about all available projects (*Capabilities*). Function *Map* implements all mandatory parameters specified by OGC *Web Map Server* specifications.

W3Trigger (Figure 6) is component (*ActiveX* (DLL) responsible for starting Web Map server (MapWorldWide) via Internet.
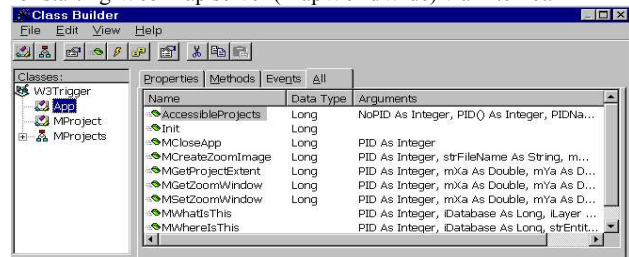

Figure 6: W3Trigger classes

W3Catalog
W3Catalog (Figure 7) is a component (*ActiveX* EXE server) that enables administration and management with projects. Any project can be active or passive, and all the services could be stopped or activated by using this component (Start/Stop).
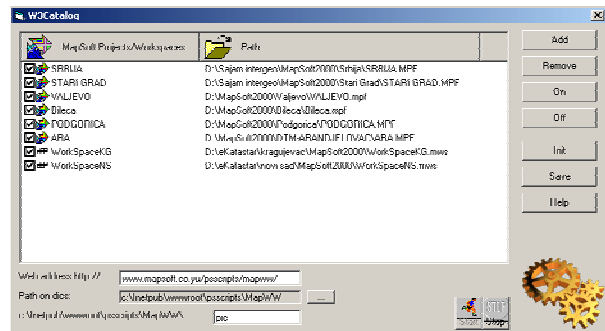

Figure 7 : W3Catalog

All settings specific to some specific project (active layers, colors, raster images display, labels, etc.) are to be modified by using *MapSoft 2000 Server*.

2.4.3 Link to cadastral data - CadastarWorldWide

CadastarWorldWide is component that enables access to cadastral data located within official databases. These databases are located on Novell server and they are managed by old DOS application using FoxPro RDBMS. Internet appplication CadastarWorldWide uses Windows OLEDB drivers for direct and simple access to these databases. Some functions for executing most of the standard queries required by cadastral officers of GGA are developed and provided.

AdminWorldWide, UtilWorldWide
AdminWorldWide is Internet application enabling administration of system users (accounts, rights, etc.
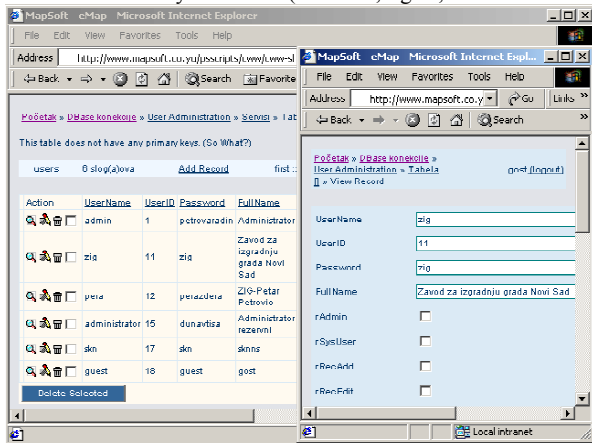

Figure 8 : Admin World Wide

UtilWorldWide is Internet application for support to placing orders for some data, statistical reports on system usage, etc.

2.5 Services available to user

Services are means of communication used for distribution of data to the users. They are the top of an iceberg. There are software, hardware and people behind who collect and maintain the data used by these services. Currently the system is capable of working with daily updated data and the following services are provided:

Browsing land cadastre and real estate cadastre data:
- Parcel data
- List of owners of the rights on parcel
- List of objects (buildings) on parcel
- List of all parcel parts
- List of owners of the rights on parcel objects
- List of all legal on parcel
- List of all legal on object
- Search by name
- Search by street name and address
- Etc.

Display of DGP data and orthophoto maps:
- Data search
- Zoom/pan
- Link to graphical and alpha-numerical data

2.6 System users

One of the major obstacles for the realization of any project that includes digital cadastral data distribution was the legal issue. Existing bylaws, regulations and price lists do not take into consideration the possibility of selling or giving data. Proposal of changes and supplements of '*Bylaw on fees for using state survey and cadastral data and services from Government Geodetic Authority*' (Government Geodetic Authority, 2002), has provided, for the first time, a basis for practical application of digital data distribution. Based on this bylaw proposal, and on the decision of the RGZ director, a contract was signed in April 2002 (Table 8) with the Institute for construction of town of Novi Sad (ZIG) on three-month experimental cadastre system exploitation. Later, commercial contracts with the same institution and with the JP Urbanizam were also signed.

User	Use period	Number of queries
SKN Novi Sad	April 2002.	~15000
ZIG Novi Sad	May 2002.	~40000
JP Urbanizam	May 2003.	~25000

Table 9: Statistics of system usage * *cadastre* by users
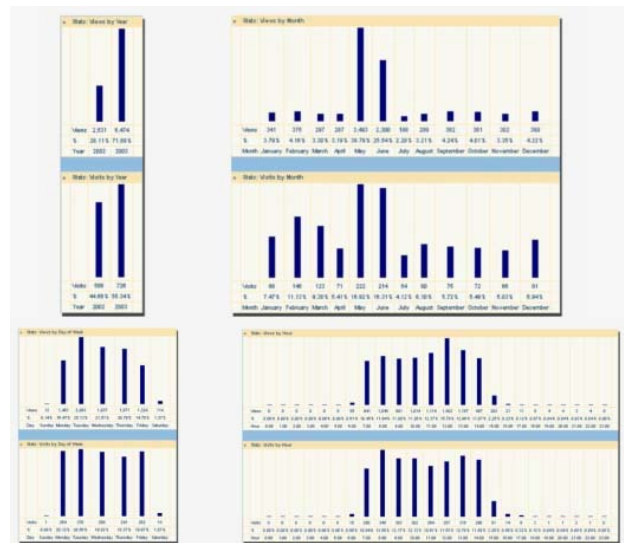*data available on April, 2004.

Figure 10: eCadastre: System usage by years, months, days and hours

2.6.1 eCadastre usage analysis

eCADASTRE system was implemented in the middle of April 2002 and the exploitation started at the end of April 2002 (Vojinovic, 2002), after the contract with ZIG had been signed. Based on statistics on system access (CWWStat) it can be noticed that:
- System is evenly used during work time;
- System is evenly used during the week;
- Access rate from 'outside' (ZIG Novi Sad, JP Urbanizam) is very similar, while access rate from 'inside' (SKN Novi Sad) is lower;

During the system usage some errors were discovered, mainly those related to data quality. Typical examples are: differences between data from maps and those from land cadastre or real

estate cadastre. Also there are some parts of the maps with missing digitized data and some others. These errors are registered and corrected on a daily basis.

2.7 eCadastre today

System for DGP data, land cadastre data, and real estate cadastre data distribution via intranet/Internet – eCadastre is designed and implemented as a pilot project (Vojinović, M, 2001a). Project objective was to test possibilities of using cadastral data via intranet/Internet and to relax load on cadastral office made by users of cadastral data. During project realization, due to the interest shown by prospective users, and thanks to the readiness for the cooperation shown by RGZ and local/regional cadastral managements the project has been extended:

- Data for the whole political municipality of Novi Sad is included;
- It has been decided to distribute all the data (land cadastre and real estate cadastre) available within SKN Novi Sad;
- Data for all cadastral municipalities with available DGP data is included;
- Complete archive of geodetic maps is available (all the maps are scanned and points representing parcels are digitized);
- SKN Novi Sad is connected to city intranet (necessary communication equipment is installed).

Today, *eCadastre* represents a system with the following characteristics:

- Data is updated on a daily basis and distributed (land cadastre, real estate cadastre and DGP data);
- System has permanent commercial users (ZIG and JP Urbanizam) as well as users from the cadastre;
- 24 hours, 7 days in a week, users have access to the cadastral data;
- System users from SKN Novi Sad use services in their everyday jobs business.

It has been planned to extend a number of intranet users:

- Customers that visits cadastral office;
- Public and municipality utilities companies;
- City departments;

It has been planned to extend a number of Internet users:

- Privately owned surveying agencies and lawyers offices;
- Residents.

3. CONCLUSION

At this moment, local cadastral offices are making data, deal with their processing and distribution, but there are no standard procedures for exchange of those data. Analyses of data covering territory larger than a single political municipality are made in the following way: local or regional offices are ordered to prepare the data in a specified (for that occasion) data format and to send them to the center where those data will be gathered and analyzed. System for cadastral data distribution – eCadastre is also based on this concept, because there are no technical or organizational possibilities for different approach (Vojinovic 2001b, Vojinovic 2004).

Modern concept should provide that all the cadastral data pertaining to the whole region or even to the whole republic are kept within a single logical database. This would significantly improve possibilities for data analyses. This would also simplify data distribution, because the system that is to be installed and maintained on one place is much cheaper and easier for administration then distributed systems throughout the country.

Due to the complexity of the problem it is very important to test all the vital system components. Therefore, the following tests should be made:

- To test the performances of the access to the system that would contain all the data from the Novi Sad region;
- To test the possibilities of system data update from remote local offices;
- To provide system access from Internet.

Concerning legal aspects, it can be stated that '*Bylaw on fees for using state survey and cadastral data and services from Government Geodetic Authority*' provides framework for distribution (selling and public access) of cadastral data via intranet/Internet. When current legislation and standards are concerned, it is recommended to prepare and accept suitable standards that would define data exchange format. This is necessary for all the data – spatial (DGP) and non-spatial.

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