The IT System of the National Cadastre of Greece

Lefteris LYKOUROPOULOS and Georgios Mourafetis NIKOLAOS, Greece

Key words: Cadastre, IT, Greece

SUMMARY

Ktimatologio S.A. is the National Cadastre Company created in 1994 by the state to supervise the collection of topographic and legal information related to land parcel ownership and to serve as the legal custodian of this information for the general public. Today, the state has upgraded the role of Ktimatologio S.A. to collect and manipulate the Cadastre data, thus becoming the National Cadastre.

During last year Ktimatologio S.A. developed an in-house IT system utilizing state-of-the-art technologies. Today the system is live and operates with several dozen Cadastral Offices with on line parcel reference and associated legal ownership information and reports to the general public. Major GIS and database applications were developed to provide the needed robustness and scalability for spatial and attribute data.

The spatial data management is performed in the central offices of the National Cadastre using specialized software developed to match Greek legislation. Attribute data is on the other hand managed remotely through the cadastral offices using Internet based software developed in house.

Error checking, internet services, loading procedures, data management, history are only some of the domains for which in house development has occurred.

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1. CADASTRAL DATA

Cadastre began in Greece in 1995 when the first collection of survey and descriptive data were assigned to several contractors for some territories. The kind of data that was gathered included:

1.1 Descriptive Data

– Registrable rights
– Beneficiaries
– Deeds
– Applications

1.2 Spatial Data

– Municipality Boundaries
– Land Parcels
– Buildings
– Mines
– Exclusive use areas
– Easements
– Orthophotographs
– Digital Terrain Models
– Survey maps

Greek Cadastre kept on collecting this type of data up to 2002 where a first effort was made to create an IT system that would be able to:

– Store all the data gathered
– Link them together
– Provide fast and accurate information
– Qualify it & provide quality control

2. PRINCIPLES THE IT SYSTEM SHOULD IMPLEMENT

– Central storage of all data, both spatial and descriptive inside Ktimatologio S.A.
– Cadastral Offices should be able to access these data
– Data editing and manipulation and reporting
– Data integrity
– On line production of Cadastral sheets, Cadastral extracts and Extended Cadastral extracts
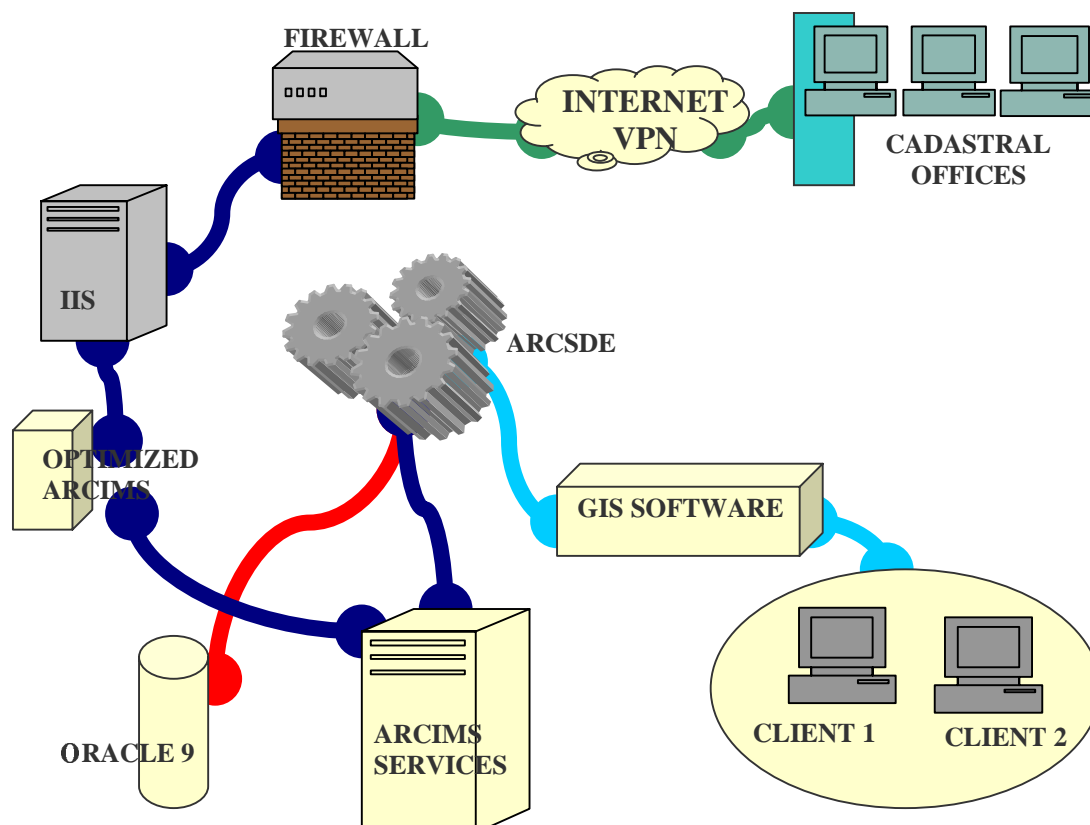

- Navigation through spatial and descriptive data in order to help citizens locate their properties and changes that affect them.
- 8 by 5 operation
- Disaster center and off site backups
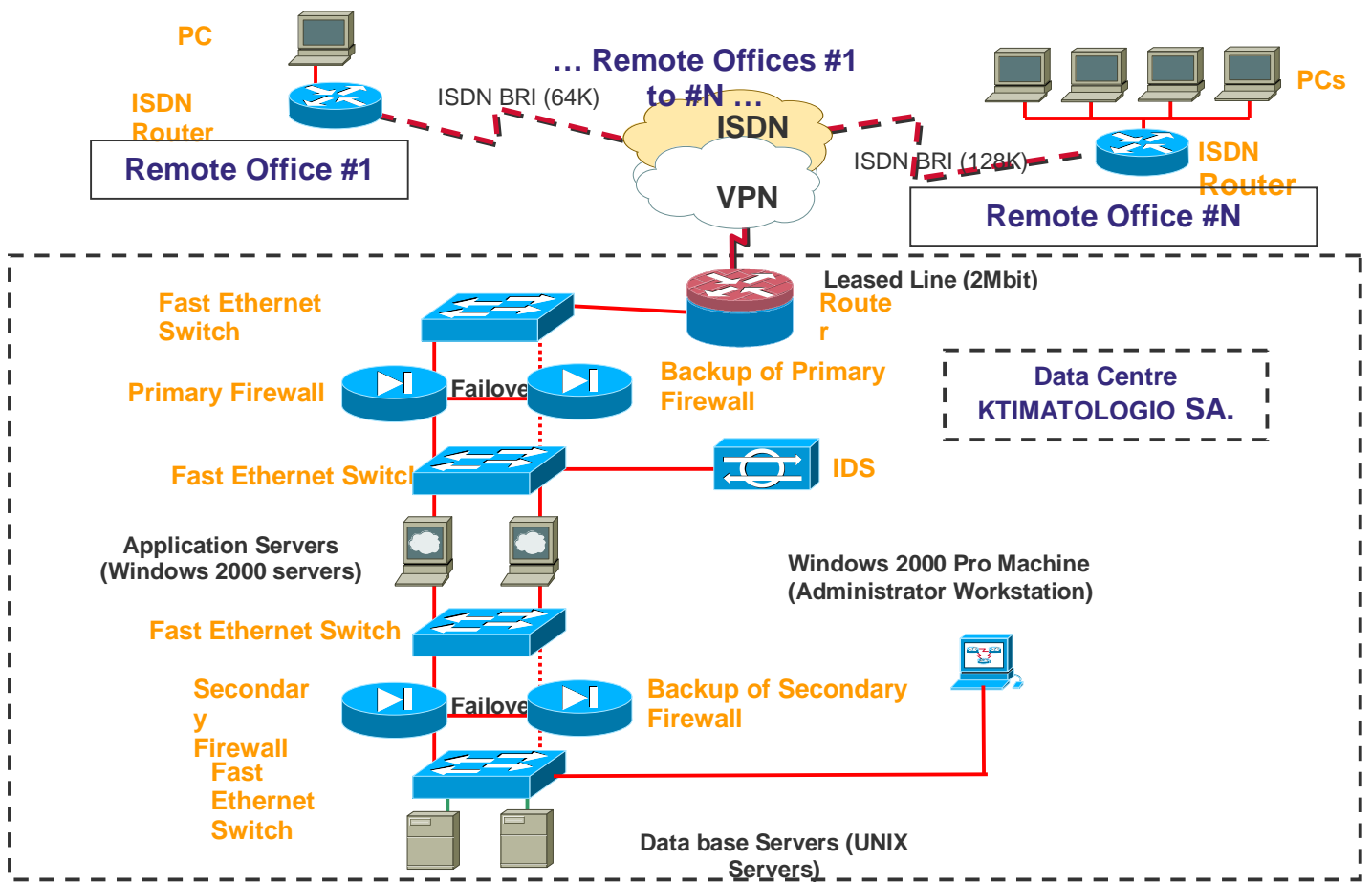- Security

3. CREATING THE IT SYSTEM

The development of the IT System followed different directions regarding the remote management of data for the spatial and descriptive data. Remote editing and registration was allowed only for legal data as this was the only kind of data that the supervisors of the Cadastral offices were permitted by Law to operate. Spatial data handling requires the presence of surveyors, which was out of the scope and budget at that time.

Cost analysis revealed that ISDN lines would be a cost efficient means to access data from small and average remote Cadastral Offices. The bandwidth would depend on the size of the remote office and on the average daily requests. The system detailed presentation can be seen in diagram (3.2). Diagram (3.1) shows the spatial system design and the software used and diagram (3.3) has a mixed overview of both spatial and descriptive approaches.
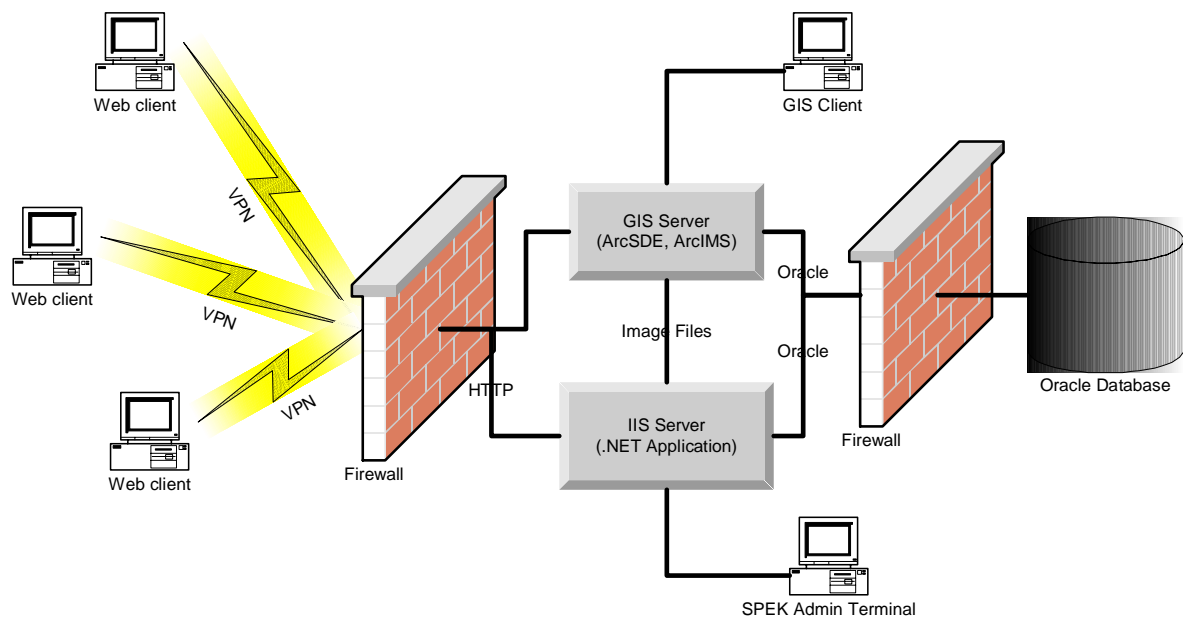
3.1 System Overview

3.2 System Overview

PC

ISDN Router

Remote Office #1

ISDN BRI (64K)

… Remote Offices #1 to #N …

ISDN

VPN

PCs

ISDN BRI (128K)

ISDN Router

Remote Office #N

Leased Line (2Mbit)

Fast Ethernet Switch

Router

Primary Firewall Failove **Backup of Primary Firewall**

Data Centre KTIMATOLOGIO SA.

Fast Ethernet Switch

IDS

Application Servers (Windows 2000 servers)

Windows 2000 Pro Machine (Administrator Workstation)

Fast Ethernet Switch

Secondary Firewall Failove **Backup of Secondary Firewall**

Fast Ethernet Switch

Data base Servers (UNIX Servers)

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3.3 System Overview

4. GIS

GIS and descriptive database systems were developed separately. Both kinds of data are stored and handled by the same database, which is ORACLE 9.2. GIS uses ESRI technology such us ArcGIS 8.2, ArcSDE 8.2 and ArcIMS 4.01 as shown in diagram 3.3 above. ArcSDE does not use Oracle Spatial but the SDE schema as implemented by ESRI.

All Data are stored and handled according to which municipality they belong to. In most cases a whole municipality is handled exclusively by one cadastral office.

Restrictions and rules apply to each different dataset, all of which are handled by applications developed in house.

4.1 GIS Software Applications of Ktimatologio S.A.

All the software developed in house can be categorized into the following general categories:
- Quality control software
- Data Loading software
- Data management and editing software
- Product Creation software
- Internet Software

4.1.1 Quality control software

According to the existing specifications, all the spatial data delivered to the Cadastral should by in one of the following formats: Dxf, ShapeFile or custom Ascii files. As it is well known,

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none of the above formats includes topological information that Ktimatologio could use to check the data it receives.

All the data received by the Cadastral are converted to arc/Info workstation coverages formats and then checked with a sequence of specially developed aml scripts. The first outcome of the quality control process generates a) tables with error coordinates and b) explanation and text documents with customized error codes. The spatial data are also checked according to the records of the descriptive data provided to Cadastral in Microsoft Access database format (mdb) by the contractors.

Contractors that deliver spatial data in Shapefile format, use extra software developed for them in Map Objects 2.2 for quality control. This software is provided free of charge to the contractors by Ktimatologio as long as they have Map Objects 2.2. installed on their computers. The software can locate overlaps, gaps, duplicate data, wrong field definitions and provide Shapefiles for each separate case of error and a Microsoft access database with database checks. Diagram 4.1.1.1 shows the way data is provided to the quality control and the results that can by viewed on the reviewer's screen. Blue indicates an error and red indicates the bounding box of all the errors that belong to the specified category. The user can navigate through the data and request attribute information for each parcel as an assistance to pin point the problem.

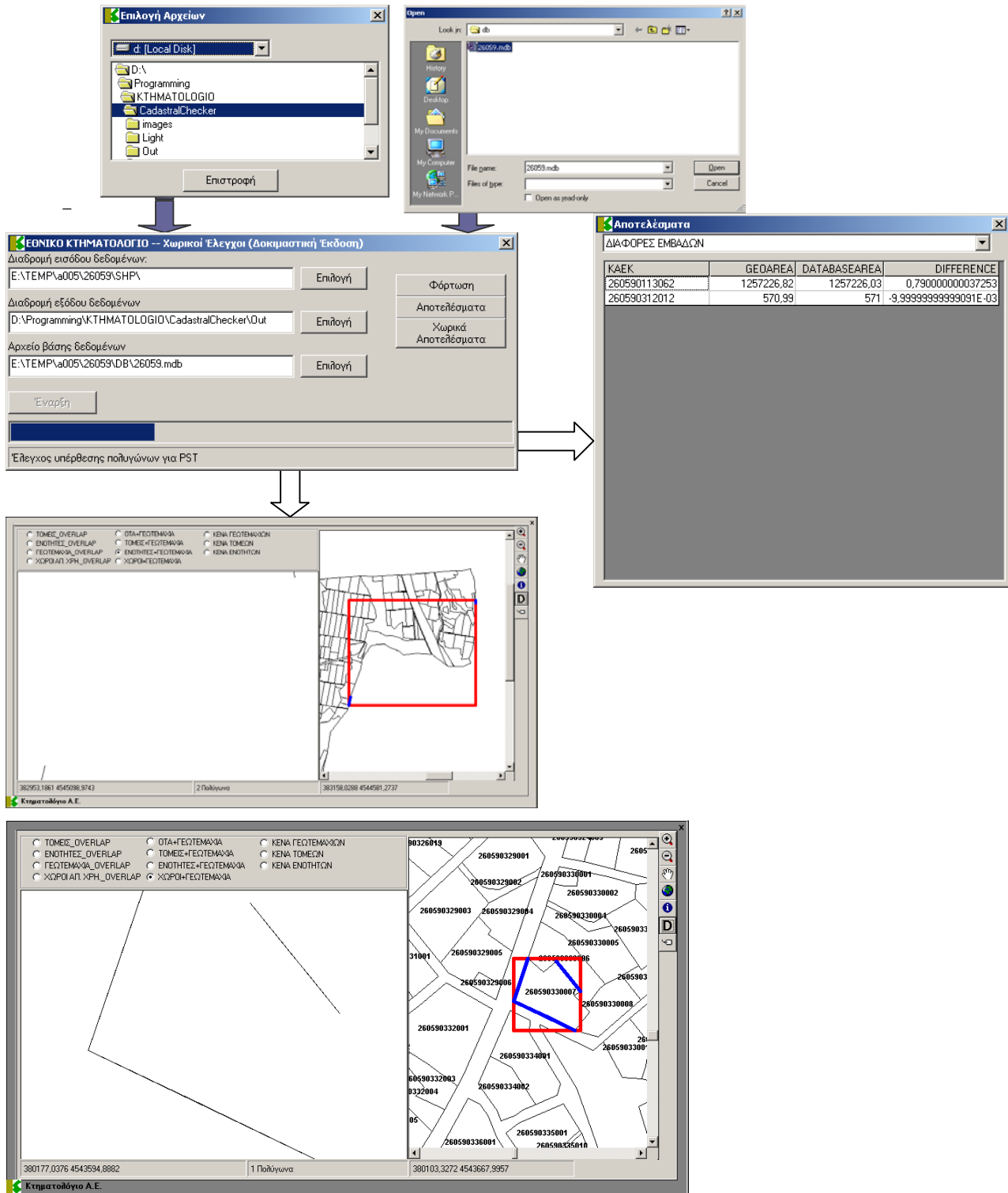### 4.1.2   Data loading software

The output from the quality control is always an Arc/Info coverage customized according to certain specifications. This coverage is input to the data loading software that is responsible for the execution of the following tasks.

- Creation of new Fields, deletion of old ones
- Calculation of values for various fields
- Creation of new ArcSDE Layers deriving from source data.
- Creation of new tables for use with the data management software
- Loading of the coverage data to the according SDE schema in ORACLE
- Updating all the elements required for use by other applications
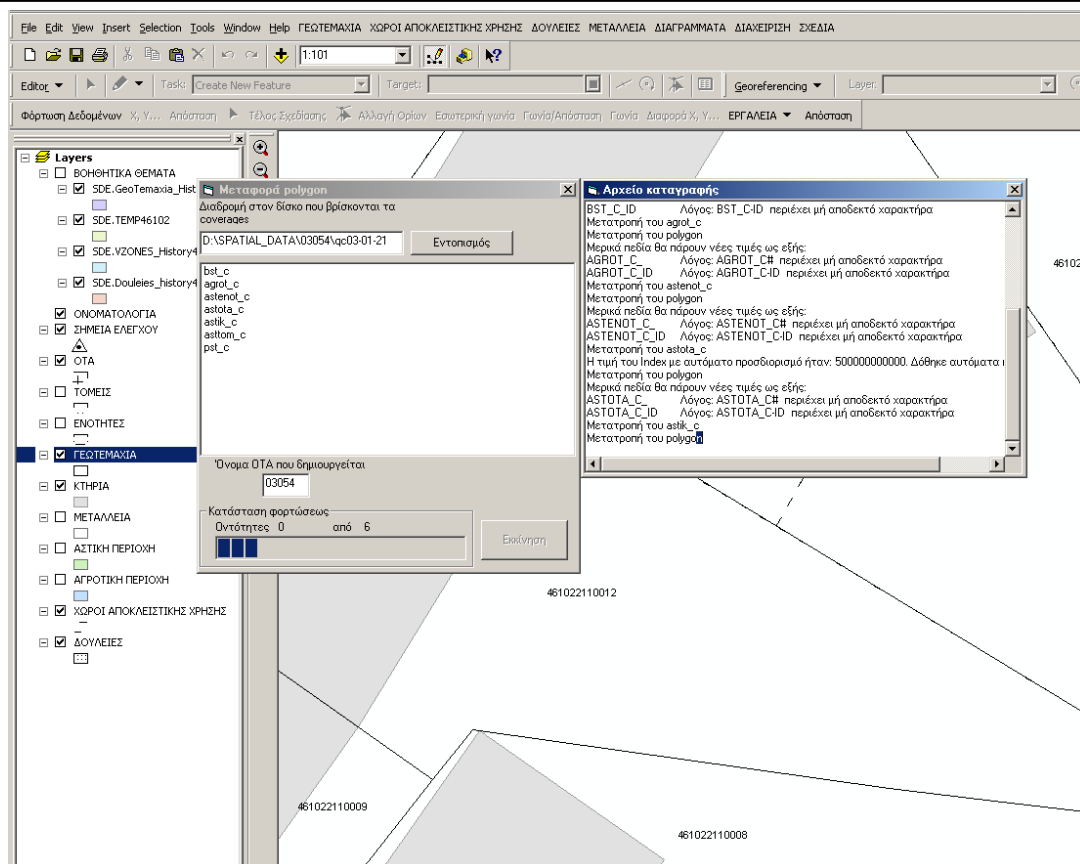- Creation of the web pages that will by used with ArcIMS

Creating a Log File with all the problems found and actions that took place.

Loading data is a multi-step process that has been fit into a single button click. Thus Ktimatologio uses minimum consumption of time and effort. Diagram 4.1.2.1 shows a data loading process in progress.

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Diagram 4.1.1.1 Data input to the Quality Control Software and calculated errors.

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Diagram 4.1.2.1 Data loading in progress

4.1.2   Data management and editing software

As previously mentioned, data management and editing take place in the central offices of Ktimatologio S.A. Each case that results to geometrical change is examined separately and according to current procedures, is inserted in to the system.
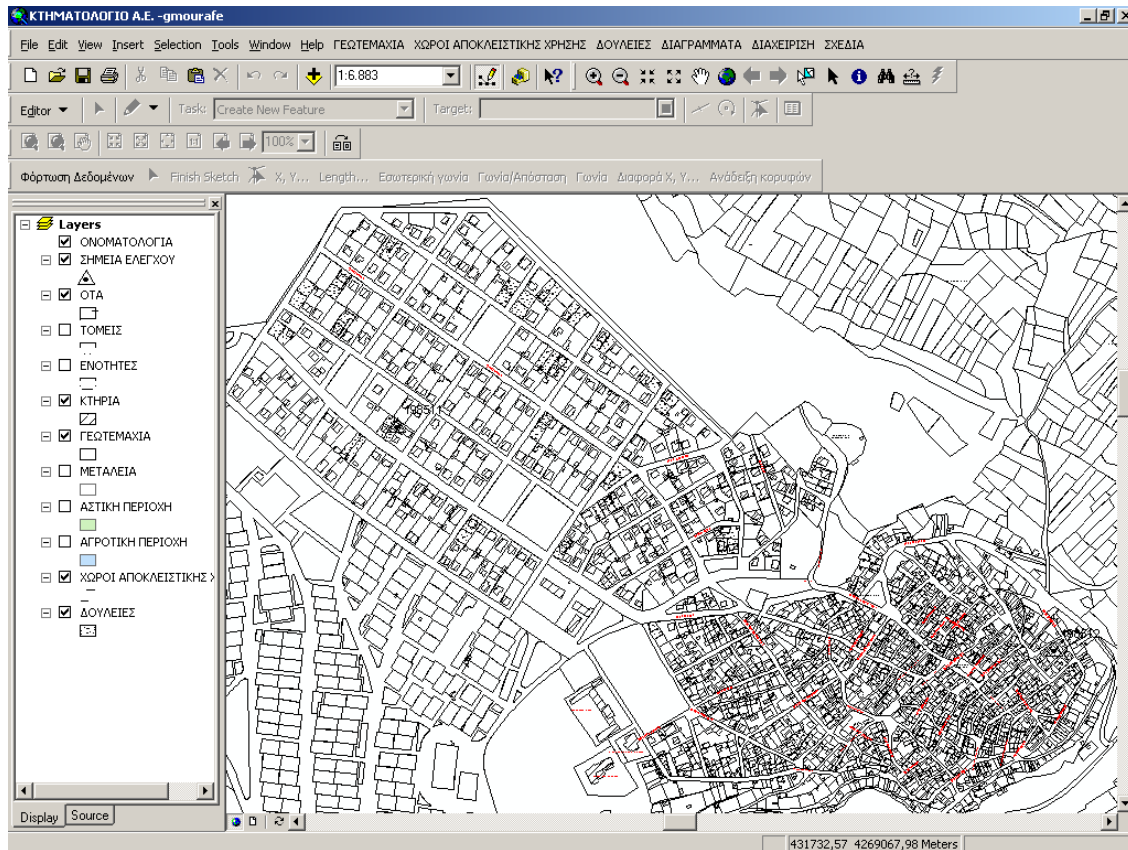
There are special users that can have edit capabilities in the system. These users are located in a secure environment and use computers that have a private network connection to the main system. All the edits are accomplished with the help of ArcGIS customized to match Ktimatologio needs. Users can only follow wizard like procedures to make any change. Each record modified is stored for history purposes and each editing action taken is logged and kept in ORACLE.

The system supports multi-user editing providing pessimistic locking mechanisms for protection of the data according to the legal system in Greece. The administrator defines the actual view of the themes that is available to each user and the commands that he/she is allowed to execute. Diagram 4.1.3.1 gives an idea of what the users see through the software and diagram 4.1.3.2 illustrates some of the developed customized commands. Diagram

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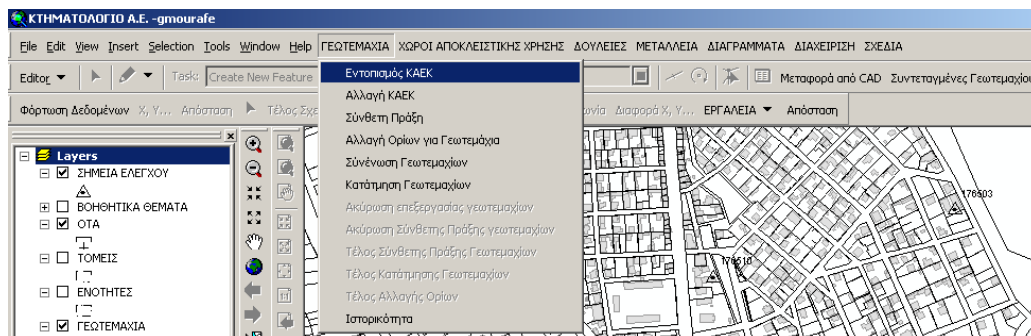Athens, Greece, May 22-27, 2004

4.1.3.3 shows some of the reports generated before the actual change occurs and diagram 4.1.3.4 reveals the history records that are kept for a particular parcel.
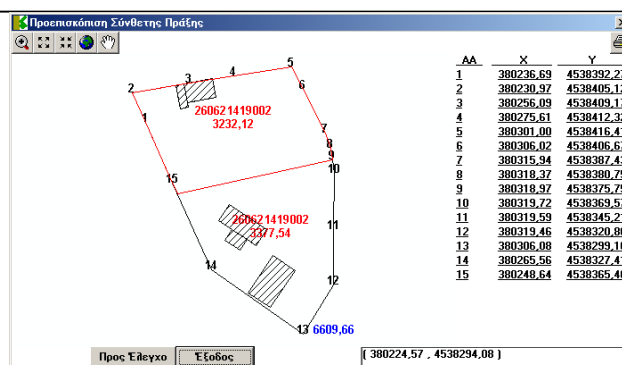
Diagram 4.1.3.1 the first view of a user that loads a municipality from the system

Diagram 4.1.3.2 Custom commands created to match Cadastral needs

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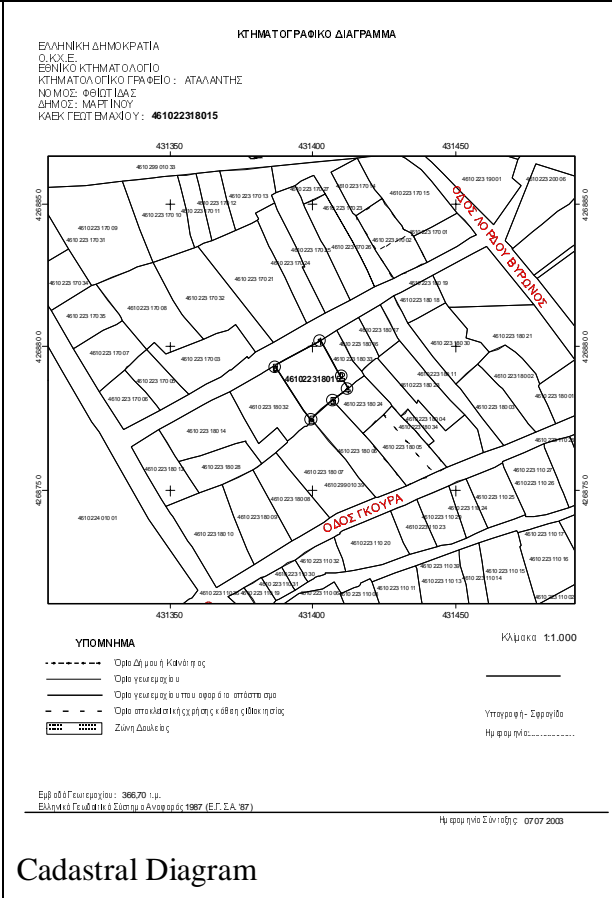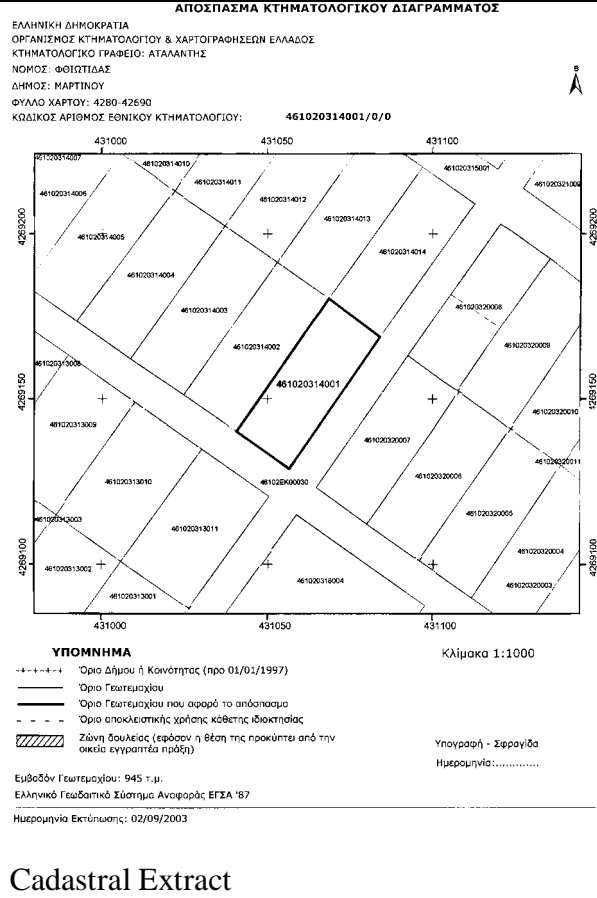> **Diagram 4.1.3.3** Reports generated by the system before the actual change takes place

> **Diagram 4.1.3.4** History versions of a parcel as it is presented automatically by the system
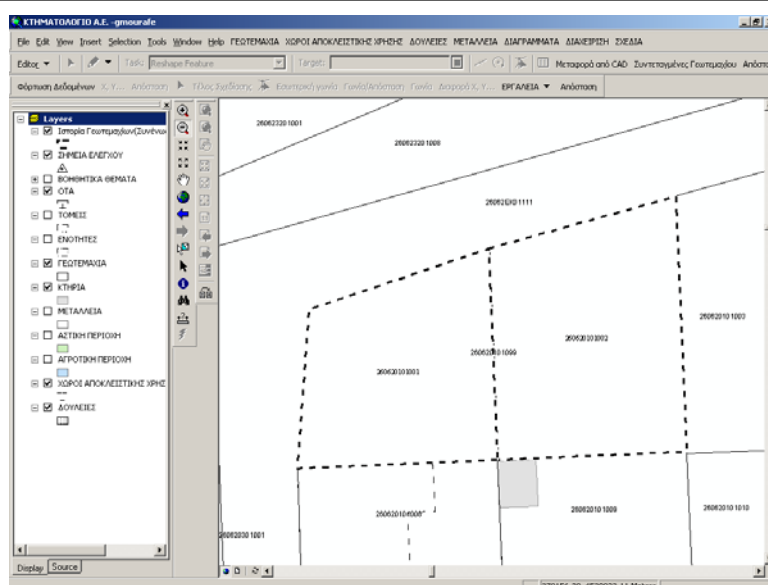
4.1.4 Product Creation software

Product creation software is part of the ArcGIS based software developed to perform the data manipulation. Some of these are produced on line from the remote cadastral offices and some are created at Ktimatologio S.A. by the in house software and then posted out to the Cadastral offices. Bandwidth is the main reason for which full remote process is not implemented, as some of the products require several Mbytes of storage. Some products can be seen in diagrams 4.1.4.1 and 4.1.4.2

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Diagram 4.1.4.1 Products of the Software

ΑΠΟΣΠΑΣΜΑ ΚΤΗΜΑΤΟΛΟΓΙΚΟΥ ΔΙΑΓΡΑΜΜΑΤΟΣ

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΟΡΓΑΝΙΣΜΟΣ ΚΤΗΜΑΤΟΛΟΓΙΟΥ & ΧΑΡΤΟΓΡΑΦΗΣΕΩΝ ΕΛΛΑΔΟΣ
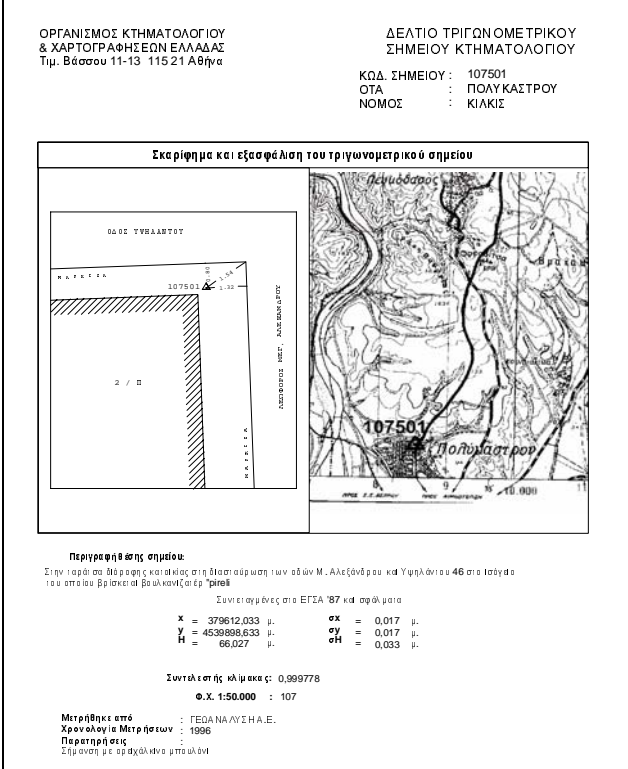ΚΤΗΜΑΤΟΛΟΓΙΚΟ ΓΡΑΦΕΙΟ: ΑΤΑΛΑΝΤΗΣ
ΝΟΜΟΣ: ΦΘΙΩΤΙΔΑΣ
ΔΗΜΟΣ: ΜΑΡΤΙΝΟΥ
ΦΥΛΛΟ ΧΑΡΤΟΥ: 4280-42690
ΚΩΔΙΚΟΣ ΑΡΙΘΜΟΣ ΕΘΝΙΚΟΥ ΚΤΗΜΑΤΟΛΟΓΙΟΥ: **461020314001/0/0**

ΥΠΟΜΝΗΜΑ

-·-+-·-+-·- Όριο Δήμου ή Κοινότητας (προ 01/01/1997)
————— Όριο Γεωτεμαχίου
━━━━━ Όριο Γεωτεμαχίου που αφορά το απόσπασμα
- - - - Όριο αποκλειστικής χρήσης κάθετης ιδιοκτησίας
▨ Ζώνη δουλείας (εφόσον η θέση της προκύπτει από την οικεία εγγραπτέα πράξη)

Εμβαδόν Γεωτεμαχίου: 945 τ.μ.
Ελληνικό Γεωδαιτικό Σύστημα Αναφοράς ΕΓΣΑ '87

Κλίμακα 1:1000

Υπογραφή - Σφραγίδα
Ημερομηνία:.............

Ημερομηνία Εκτύπωσης: 02/09/2003

Cadastral Extract

ΚΤΗΜΑΤΟΓΡΑΦΙΚΟ ΔΙΑΓΡΑΜΜΑ

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Ο.Κ.Χ.Ε.
ΕΘΝΙΚΟ ΚΤΗΜΑΤΟΛΟΓΙΟ
ΚΤΗΜΑΤΟΛΟΓΙΚΟ ΓΡΑΦΕΙΟ: ΑΤΑΛΑΝΤΗΣ
ΝΟΜΟΣ: ΦΘΙΩΤΙΔΑΣ
ΔΗΜΟΣ: ΜΑΡΤΙΝΟΥ
ΚΑΕΚ ΓΕΩΤΕΜΑΧΙΟΥ: **461022318015**

ΥΠΟΜΝΗΜΑ

-·-·-·-·- Όριο Δήμου ή Κοινότητας
————— Όριο γεωτεμαχίου
- - - - Όριο γεωτεμαχίου που αφορά το απόσπασμα
- - - - Όριο αποκλειστικής χρήσης κάθετης ιδιοκτησίας
▨ Ζώνη Δουλείας

Εμβαδόν Γεωτεμαχίου: 366,70 τ.μ.
Ελληνικό Γεωδαιτικό Σύστημα Αναφοράς 1987 (Ε.Γ.Σ.Α.'87)

Κλίμακα 1:1.000

Υπογραφή - Σφραγίδα
Ημερομηνία:.............

Ημερομηνία Σύνταξης: 07 07 2003

Cadastral Diagram

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Diagram 4.1.4.2 Products of the Software

ΑΠΟΣΠΑΣΜΑ ΣΗΜΕΙΩΝ ΕΞΑΡΤΗΣΗΣ

ΚΛΙΜΑΚΑ: 1:50.000

O   Τριγωνομετρικό Σημείο

Ι   Σημείο Αστικού Δικτύου Εθνικού Κτηματολογίου

Οι συντεταγμένες και τα αναλυτικά στοιχεία των σημείων των Δικτύων του Εθνικού Κτηματολογίου δίνονται στα παρακάτω δελτία.
Οι συντεταγμένες των τριγωνομετρικών σημείων του Κρατικού Τριγωνομετρικού Δικτύου, χορηγούνται από την ΓΥΣ (ΟΚΧΕ).

First Page of Control Points Extract

ΟΡΓΑΝΙΣΜΟΣ ΚΤΗΜΑΤΟΛΟΓΙΟΥ
& ΧΑΡΤΟΓΡΑΦΗΣΕΩΝ ΕΛΛΑΔΑΣ
Τιμ. Βάσσου 11-13 115 21 Αθήνα

ΔΕΛΤΙΟ ΤΡΙΓΩΝΟΜΕΤΡΙΚΟΥ
ΣΗΜΕΙΟΥ ΚΤΗΜΑΤΟΛΟΓΙΟΥ

ΚΩΔ. ΣΗΜΕΙΟΥ :   107501
ΟΤΑ   :   ΠΟΛΥΚΑΣΤΡΟΥ
ΝΟΜΟΣ   :   ΚΙΛΚΙΣ

Σκαρίφημα και εξασφάλιση του τριγωνομετρικού σημείου

Περιγραφή θέσης σημείου:

Στην παράπλα διάραξης κατοικίας στη διασταύρωση των οδών Μ. Αλεξάνδρου και Υψηλάντου 46 στο ισόγειο του οποίου βρίσκεται βουλκανιζατέρ "pireli"

Συντεταγμένες στο ΕΓΣΑ '87 και σφάλματα

x	=	379612,033	μ.	σx =	0,017 μ.
y	=	4539898,633	μ.	σy =	0,017 μ.
H	=	66,027	μ.	σH =	0,033 μ.

Συντελεστής κλίμακας: 0,999778

Φ.Χ. 1:50.000   :   107

Μετρήθηκε από   :   ΓΕΩΑΝΑΛΥΣΗ Α.Ε.
Χρονολογία Μετρήσεων : 1996
Παρατηρήσεις   :
Σήμανση με σιραχάλινο μπουλόνι

Φύλλο : 2

Second Page of Control Points Extract

Photograph of a Control Point

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4.1.5 Internet Software

Internet mapping is available with the help of ESRI ArcIMS. Customizing the capabilities ESRI offers, gives each cadastral office the ability to navigate through spatial information over Internet. Diagram 4.1.5.1 illustrates such a view.

Diagram 4.1.5.1 a view of spatial data for a municipality through Internet
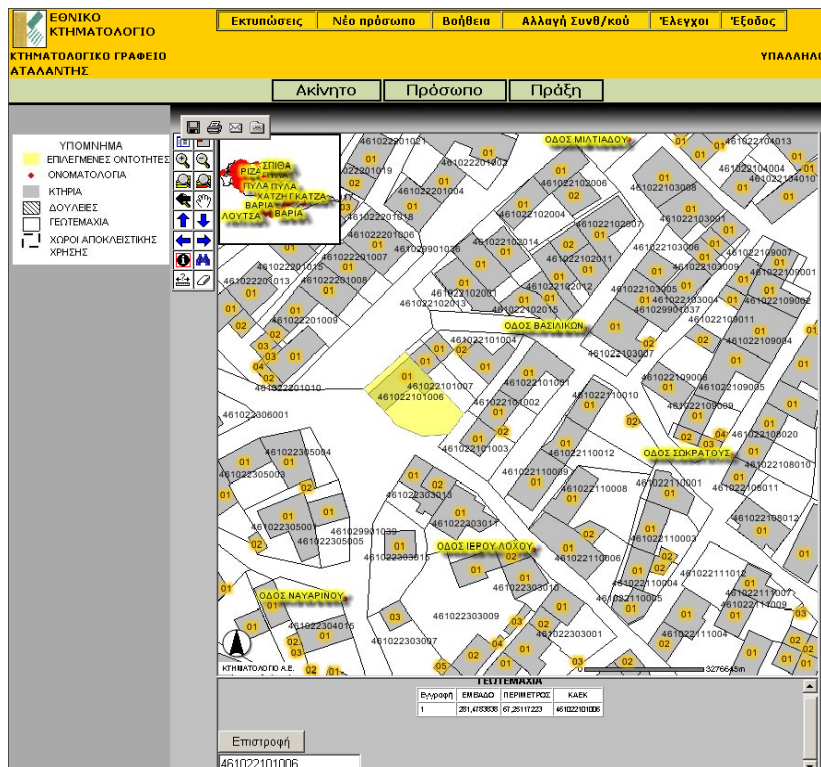
5. LEGAL INFORMATION SYSTEM OF NATIONAL CADASTRE

As mentioned before, spatial data entry and manipulation is allowed only to employees located inside Ktimatologio S.A. On the other hand legal data can only be edited over Internet with the use of a web application developed in house. The web application is based on .NET and IIS technology. Some aspects of it are:

– High Security Levels using encryption, VPN and Firewall systems
– Validation rules for detecting obvious errors.
– On line data matching and error detection.
– Friendly user interface
– Online Certificates

Diagram 5.1 shows some aspects of the web application each cadastral office uses.
Diagram 5.2 shows a certificate issued on line by the system.

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Diagram 5.1 Screenshots of the web application for the handling of descriptive data

Diagram 5.2 Online certificate issued by a cadastral office

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BIOGRAPHICAL NOTES

Lefteris Lykoyropoulos is the IT Director of Ktimatologio SA. Born in Athens in 1968, is specialized through his postgraduate studies in analysis, design and implementation of large Databases, using popular RDBMS of the industry. He has led and managed the creation of the IT system during the last year, including quality control tools and data transfer procedures of legal data and the DB design and implementation.

Giorgos Mourafetis is the IT manager in charge of the GIS department of the Ktimatologio SA,. Born in Athens in 1977, he is a Rural and Surveying Engineer (National Technical University of Athens) and a postgraduate student of the Geoinformatics Department of NTUA. He has designed and developed the GIS application (interface, procedures) of the system, quality control tools, data-transfer procedures of spatial data, cartography and automatic map generation issues. He has designed and developed many applications in Greece covering large projects of the public and private sector solving GIS, hydrological, topographical, photogrammetrical and agricultural issues.

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