Distributed Territorial Data Management and Exchange for Public Organizations

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Abstract

Development of Information Systems based on territorial data (e.g., land planning, geo-marketing, vehicle management, traffic guidance, ...) is usually highly complex and expensive. A large part of the cost is due to the fact that the real value of geographical data for a given application purpose is highly dependent from the match between data quality characteristics and the application target.

On the other side, large availability and easy exchange of territorial data relative to a given region are fundamental ingredients to support economic development in many service sectors that are increasingly and increasingly based on Information Technology systems. Hence a critical issue for any public administration in its role as a policy making organization is the definition of a techno-organizational infrastructure ensuring, at the same time, cooperation and competition in this critical market.

In this paper we describe fundamental ideas underlying a possible approach to deal with such an issue. The lines here discussed have been implemented and tested in a system prototype developed in Italy, whose realization was promoted by AIPA, the italian Authority for Informatics in Public Administration.

Keywords: territorial data distribution and exchange, web-based information system, competition in public services, virtual market, inter-organization cooperation.

1 Introduction

A widely used practice in the development of Information Technology (IT) systems based on territorial data is, for a new system to be developed, to re-collect raw data about the concerned portion of land and then develop software processes supporting a given set of functional requirements. A large part of the cost involved in this approach is due to the fact that geographical data collection is, notwithstanding new GPS-based technologies and their related IT procedures, a intrinsically highly expensive process.

Hence such a sector is not developing as it could be, given the current computational power available in IT-based systems and the huge size of territorial data already collected.

The italian Authority for Informatics in the Public Administration (AIPA), has therefore launched a research and development project (SCT – "Sistema di Comunicazione di Dati Territoriali") to investigate technical and organizational issues to allow lowering of costs related to geographical information systems development and maintenance, to enable a true reuse of geographical data by many users and many organizations and thus foster the development of a market for territorial data.

The design and prototyping of SCT system was carried out by a consortium led by Telecom Italia and comprising three more large companies (namely, ESRI, Finsiel and IBM). Such a project is one of the steps taken by AIPA in the joint cooperation framework[1] with the Region Asso-

[1] Namely, "Intesa Stato-Regioni-Enti Locali per la Realizzazione dei

ciation and the Municipality Association for coordinating efforts related to geographical information systems. Results of further AIPA's efforts in this area are described in [1, 2, 4, 5].

SCT's services allow administrations to get information needed to decide, on the basis of their own criteria, technical and economical feasibility of the use of territorial data available by means of SCT within administrative processes internal to the administration itself.

From a functional point of view SCT can be described at a high level as a set of distributed processes to certify:

- the existence of geographical data at providers' sites,
- the use, at end-users' sites, of geographical data retrieved by means of the system itself.

These processes therefore enable the publication and access to territorial data available through the system itself, by connecting providers and end-users of data.

A key role in this infrastructure is played by SCT's Managing Agency, which, by means of an appropriate management of SCT services, can act as a policy maker and a mediator between geographical data providers and end-users and can guarantee and certify the correct flowing of publication and supply services. Its functions may be partitioned among more than one organizations, if this is required by organizational constraints.

In such a way SCT's Managing Agency can foster cooperation among administrations to build territorial information bases focused on specific sectors (e.g., transportation) with considerable saving of resources. In fact, SCT constitutes a mediating "virtual place" among local and central administrations, where different needs and requirements can find an equilibrium and lead to the cooperative development of new geographical databases, when existing ones are not reusable.

Key architectural aspects of SCT are:

- the description of geographical data through metadata,
- mechanisms for data geo-referencing and certification,
- the definition of providers and end-users of geographical data,
- the definition and supply of data and service flows between providers and end-users.

Note that while the role of SCT is to certify existence, completeness and coherence of territorial data it gives access to and of their related documentation, it is the responsibility of each involved administration to certify reliability of data they provide. Their certification is related to the administrative processes for which data have been acquired (e.g., taxation on real estates). Reliability means, in this context, data quality, legal value of data, and validation of the data production process.

SCT therefore goes beyond the concept of a catalog of territorial data. It supports exchange and reuse of geographical information based on schemes (or patterns) of use of data declared by end-users as well as by providers. Potential end-users may browse through this use schemes base and discover which territorial data provide a better matching with their purposes. At the same time they can discover how to use data within administrative processes they are responsible for.

Through the cooperation and the data exchange supported by SCT it is thus possible to reduce redundancy in territorial databases and increase synergy among different uses of the same data item in different administrative processes, but all referring to the same part of land.

1.1 Related work

SCT can be considered a first attempt at implementing an IT system supporting a true cooperation in the Geographic Information System sector by means of an Internet based approach.

Its definition and design directly derive from the general approach to inter-organization cooperation, named *Access Keys Warehouse* (AKW), described in [1] and whose formal model is presented in [5].

Cooperation between IT systems of different organizations is a topic being researched since a long time, with a variable level of attention. In the last years, given the unavoidable issue of legacy systems and the explosion of network connectivity, its relevance has again increased (e.g., see the recent special issue [14]). Products allowing to deal with data access to heterogeneous information sources are being provided by all the major DBMS vendors [14] and novel approaches are being prototyped by universities (e.g., [13]). The whole area of information systems integration is a highly researched topic [9], with the goal of allowing users to make an effective use of the wealth of data easily reachable through communication networks.

A basic issue is how to keep the correlation and synchronization among representation items that, in the various organizations, refer to the same element of the reality of interest but are subject to independent evolution dynamics. This research issue is laying between the syntactic and the semantic levels. This means that we assume that syntactic homogeneity has been or can be reached, using wrappers [12, 15] if needed. Our goal, then, is not to

Sistemi Informatici Geografici di interesse generale".

reach semantic homogeneity (see the special issue [11] for a very recent discussion of semantic interoperability issues and approaches or [10] for a discussion of theoretical research issues relative to dealing with semantic heterogeneity in databases) but just to keep the representations of the same data items of the reality of interests aligned in the various databases of the cooperating organizations. Semantics of data is important to reach our goal, but it is always taken into account through direct human intervention.

The paper is structured as it follows. In Section 2 we present the overall architecture and its main subsystems. Section 3 describes exchange services of SCT, while Section 4 discusses organizational issues. Section 5 highlights SCT's role in supporting inter-organization cooperation and Section 6 concludes the paper. For a more detailed description of SCT publication services and end-user interaction see [3].

2 System architecture

A key element in SCT architecture is played by the mechanism used to describe territorial data. This is based on a metadata approach.

More specifically, organizations wishing to make their territorial data available for distribution through SCT have to give information needed to describe them in the metadata base. This Geographical Information Description (DIG = "Descrizione Informazione Geografica") is a set of metadata to be provided for each homogeneous set of territorial data. Examples of homogeneous set of territorial data are: orto-photographies of land coverage of the Ministry of Agriculture, meteorological charts of the Military Aviation Service, utilities network maps of a Region. If such a set has multiple thematic layer, that can be separately supplied (e.g., different layers for different utilities in a network utilities map), then a DIG has to be further specified to describe the various layers.

DIGs describing the same portion of land according to a same geometric partition are then grouped in *clusters*. Characteristics of territorial data are then specified only once for all DIGs in the same cluster. Each DIG therefore describes a semantically homogeneous set of geographical data, that can be supplied as a whole or in parts (datasets). A *dataset* is therefore the atomic unit of supply by SCT to end-users. For each DIG the provider has also to give a set of vectorial data, giving (according to specifications below described) geo-referencing and extension of provided dataset(s). Finally, clusters are hierarchically structured according to thematic classes.

SCT architecture is made up by the following subsystems:

- a WEB server, accessible trough Internet, managing publication services;
- a database server, extended with a geometric engine, managing both alphanumeric and geographical data in the metadata base;
- a communication subsystem, ensuring connections with RUPA [2], Internet, and possible direct links to specific providers (e.g., the Ministry of Finance which is in Italy the owner of points of the National Georeferencing Networks);
- the distributed interfaces to nodes of data providers.

2.1 Software components

Software processes can be described in terms of four components:

- CGI client component, dynamically producing HTML pages from requests and metadata base content;
- mailing client component (described in subsection 2.3), managing automatic dispatching of dataset updates;
- geometric data server component, managing data of geographical nature and allowing their visualization through a browser;
- textual data server component, managing metadata base stored in a relational DBMS;
- a communication layer supporting interaction between clients (namely, CGI and mailing) and servers (geometric engine and RDBMS).

Client components use services provided by server components to provide their own services to end-users. All components can also work in a distributed environment, so that the resulting system is highly scalable. Client and server components interact through a communication layer described below. Note that server components implement a decoupling between data (managed in the underlying RDBMS and geometric engine) and functions (implemented by servers themselves). This is a first implementation of the "Application Gateway" described in the architectural specification of RUPA's interoperability layer [7]. More specifically, servers provide to clients more advanced services than those directly available in the RDBMS and the geometric engine.

The communication layer has been defined and implemented taking into account that servers have to separate services provided to clients both from the way these are implemented in terms of the underlying RDBMS layer and from

[2] RUPA is the Unified Network of italian Public Administration

the communication layer itself. Technical requirements are therefore:

- communication layer has to guarantee error-free exchange of formatted data between different hw/sw platforms;
- communication layer has to be independent from the specific network topology;
- communication layer has to hide on the access network (RUPA or Internet) the presence of servers: end-users use their advanced services only through service functions available by means of clients.

To satisfy all these requirements the communication layer has been based on a broker middleware available on all platform (Windows and Unix) used in SCT.

The development environment has also been selected on the basis of the above requirements: the choice then was to use OM, a development environment already used in the development of major national IT projects for italian Public Administration. OM's aim is to enable inter-process communication among heterogeneous operating systems. To this aim OM's primitive communication services are based on TCP-IP. OM's architecture is made up by four main classes:

- Com_net, the core class, defining and implementing basic methods for all objects;
- Com_client, provides basic services to a client application needing to interact with a broker for reaching a server;
- Com_dbsql, implements methods to exchange SQL commands and tables;
- COmNet, is the standard interface exposed by OM clients for the purpose of Java and VisualBasic programming.

Moreover, OM provides further classes for implementing multithreaded servers providing application services to clients distributed across heterogeneous platforms (e.g., Windows, Unix, Linux):

- COmThread, the abstract class defining core services for a concurrent application in a multithreaded environment; it only provides virtual methods, to be implemented in subclasses;
- COmThreadList, implements methods to control and manage communication relative to an object;
- COMRThread, provides basic methods for a broker application;
- CVSThread, provides basic methods to set-up a server application.

In figure 1 a diagram showing structure of OM classes and their relations to the main SCT software processes is presented.

2.2 Metadata specification

It is important that each geographical data provider is fully autonomous in implementing data presentation modalities best suited to its operating context. But this requirement is clashing with the requirement of guaranteeing homogeneity of published metadata.

It is therefore needed to define a standard only for metadata content description, leaving to each provider the freedom to decide about metadata presentation form and about related technical issues.

Given the current state of Internet the best technical choice is to use XML (eXtensible Markup Language) for the above described purposes. XML has then been used to define a suitable language to be used by each provider to describe metadata (i.e., DIGs) relative to provided data. This is also the approach followed by the Federal Geographic Data Committee, the U.S. organization managing the development of the National Spatial Data Infrastructure and implementing a Geospatial Data Clearing House [8], and by the Australia-New Zealand Land Information Council, a similar organization managing the implementation of the Australian Spatial Data Directory [6].

Each SCT node at providers' sites has to publish its own metadata using XML pages defined in accordance with the Document Type Definition (DTD) specified in SCT. A document describing metadata has therefore to be compliant with DTD. A small excerpt of the proposed DTD specified in SCT prototyping activities is shown in figure 2. An example of a DIG described according to such a DTD is shown in figure 3. Both the presented examples are in italian, but keywords are easy to understand. Each provider will be free to publish its own documentation using its preferred style sheets (XSL). The revised DTD to be defined for the operating phase will thus be a true "Geographic-Metadata Markup Language" (GMML).

2.3 Automatic distribution of updates

A critical issue for ensuring a true success of data exchange services is the availability of mechanism to signal and distribute updates to each interested user, so that each one receives all and only the really relevant ones, whenever they are available.

SCT has tackled this problem by letting the user itself decide and define exactly which updates are desired. A user accomplishes this by inserting a use scheme, which describes which kind of geographical data are of interest for the user, and which are the constraints on data quality, cost, and geographical extension, and by activating for such a use scheme the *signaling* option. Parameters that can be specified for update receival are exactly the same, both textual

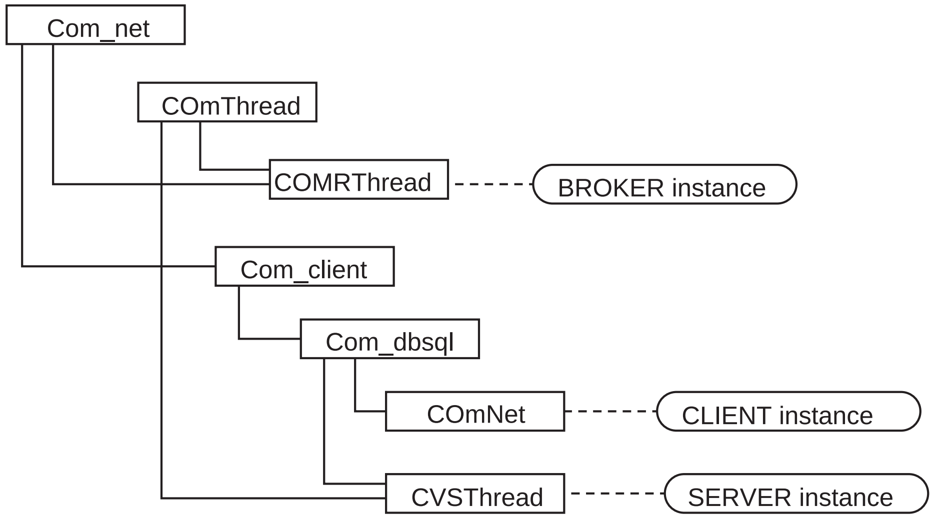

Figure 1. Organization of OM classes and instances of main software processes

and geometric ones, used in the interaction with the publication subsystem to select and retrieve relevant geographical data. In such a way, among all updates in the system, all and only those satisfying the activated use scheme(s) will be sent to the user.

The mechanism chosen in the prototype to send updates is simply the delivery of e-mail messages. This is at the same time very simple to implement and use and widely available to everybody. In the fully operational phase further and more complex mechanisms can be implemented, if needed for particular kind of users. Also, with more sophisticated distribution mechanisms it will be possible to implement also a policy for the automatic distribution of updated datasets, and not only of updated metadata.

3 Territorial data exchange services

The usual sequence of steps required to activate data exchange is the following: first the end-user, interacting with the publication subsystem of SCT retrieves territorial data of interest; then, interacting with SCT's exchange subsystem, activates the supply request; finally, a supply contract is signed (electronically, if the corresponding infrastructure has been set up), payment is activated (once again, eventually through electronic means), and data are sent.

In figures 4 an intermediate selection step by an end-user browsing through metadata base on the basis of geographical position is shown.

The exchange subsystem therefore provides all services needed to run and manage data exchange flows, including security and accounting functions. In the following, various services are discussed in more detail.

3.1 Transportation and interoperability services

This kind of services are the usual ones available on a data communication network: the only peculiarity is the large quantity of data that may be exchanged. This of course requires a bandwidth large enough to reliably and efficiently execute the exchange process.

One more peculiarity regards the relation between SCT and the Unitary Network of the italian Public Administration (RUPA) [7]. SCT is mainly devoted to public administration needs, hence it is accessed through RUPA, but since it may be used also by private organizations (and this is actually important to increase its utility), it is also possible to access it through Internet or other networks connected to Internet.

3.2 Base services

These are functions ensuring security in access and transportation of data: examples are techniques for authentication and authorization, non-repudiation of transactions, confidentiality of data exchanges, certification of data integrity, and so on. Which of these services are needed and to which degree it is mainly a matter regarding the organizational model that will have SCT operations in the final deployment phase.

```
<!  ------- DIG’s structure declaration -- >

<!ELEMENT dig (identificazione, semantica, qualita’, organizzazione, distribuzione)>

<!ELEMENT identificazione (nome, fornitore, descrizione, esempio?)>

<!ELEMENT nome (# PCDATA)>
<!ELEMENT fornitore (# PCDATA)>
<!ELEMENT descrizione (# PCDATA)>
<!ELEMENT esempio empty>
<!ATTLIST esempio src CDATA #REQUIRED desc CDATA #IMPLIED>

<!ELEMENT semantica(tipologia+)>
<!ELEMENT tipologia (ACQUA| AGRICOLTURA | ATMOSFERA | ...| VEGETAZIONE)>

<!ELEMENT qualita’(percentuale, procedura, modalita’, scala, errore, erroreq*, risoluzione)>

<!ELEMENT organizzazione(formato, classe, sistema)>
<!ELEMENT formato (ARCE | ARCG | ASCII | ...| TIFF)>

<!ELEMENT distribuzione(proprietario, distributore)>
```

Figure 2. An excerpt of the Document Type Definition proposed in SCT.

3.3 Services for data exchange

Data supply flows are fully self-identifiable, as it is the case for all service flows within SCT: this means the flow itself contains all information needed to completely identify destination of data, dataset(s) exchanged, requested service(s), data provider, and possible technical constraints on data supply. This self-identification feature, naturally ensured by the asynchronous approach adopted as basic communication protocol in SCT, is absolutely needed to ensure a true decoupling between end-users, system, and providers, hence a more efficient management of all services.

A data supply flow can be correctly executed, certified, and accounted only through a three-part relation: end-user, system, and provider. After end-user has requested a dataset and such a request has been sent to the provider, this prepares the flow according to a standard format and encapsulates dataset by means of an header allowing a correct management and routing of the flow. After a flow has been received by an end-user, this checks integrity and correctness of data contained in it. When SCT receives from the end-user the notification of the correct arrival of the requested dataset, the system is able to certify the supply service.

Data exchanged in a supply flow does not need to be in a standard file format. Instead, each provider may use the format best suited to its information system and to the tools used within it. It is only the protocol used for the exchange that has to comply with a standard defined in SCT and based on XML. Such a standard envisions mechanisms for the description of metadata and for encapsulating dataset in an header containing a standard set of information items.

Also data needed for certification and accounting of exchange flows are encapsulated by means of a standard header, predefined in SCT, containing all elements needed for these purposes.

Further services of this subsystem allow to compress data, to clip portion of data according to a given geographical boundary, to extract single data layers in a dataset, and to manage update processes for datasets.

3.4 Services relative to the organizational model

The exact organization of this kind of services will strictly depend on the way SCT will be managed in the full operation phase. They are relative to:

- documentation of service information flows,
- extraction of accounting information from service information flows,
- management of accounting services, taking into considerations both quantitative and qualitative aspects,
- management of e-commerce functions related to data exchange needs, and
- cost-benefit analysis of usability of a geographical dataset.

Concerning the control of services supplied by SCT, a suitable set of measure parameters has been identified and consequently processing functions have been implemented to allow to analyze quality and consistency of:

```
<?xml version=''1.0''?>
<!DOCTYPE dig SYSTEM ''dig.xml''>

<dig>
    <identificazione>
        <nome> Ortofoto </nome>
        <fornitore> AIMA </fornitore>
        <descrizione_estesa>
        Digital ortophoto produced from black and white aerophotogrammetry at 1 : 40.000 scale
        </descrizione_estesa>
        <esempio src=''ortofotoaima.gif'' desc=''Piazza San Pietro''/>
    </identificazione>
    <semantica>
        <tipologia> FOTOGRAFIA E IMMAGINI AEREE </tipologia>
        <tipologia> AGRICOLTURA </tipologia>
    </semantica>
    <qualita'>
        <percentuale > 100 </percentuale>
        <procedura>
        Ortophoto is produced from black and white aerophotogrammetry taken typically in spring and summer.
        The average scale is 1 : 40.000. Each picture is scanned at 256 grey levels ...
        </procedura>
        <modalita'> Rilievo diretto </modalita'>
        <scala> 1 : 10.000 </scala>
        <errore> 40 </errore>
        <risoluzione> 100 </risoluzione>
    </qualita'>
    <organizzazione>
        <formato> TIFF Tagged Image File Format </formato>
        <classe> digitale-raster-bidimensionale </classe>
        <sistema> Gauss Boaga </sistema>
    </organizzazione>
    <distribuzione>
        <proprietario> AIMA </proprietario>
        <distributore> AIMA </distributore>
    </distribuzione>
</dig>
```

Figure 3. An example of DIG defined according to the proposed DTD.

- services directly supplied by SCT,
- data and services supplied by providers,
- exchange flows requested and executed (both periodic and spot ones),
- accesses to publication service,
- data requested to SCT but not yet available, and
- declared use, by end-users, of data obtained from exchange flows.

4 SCT management model

From SCT prototyping and experimentation activities it clearly comes out the indication that the fully operational architecture for such an infrastructure is a totally distributed one.

This means that each organization wishing to act as a provider of territorial data through SCT sets up a “node” of such a distributed infrastructure, where its own data, and metadata describing them, are available and can be accessed by SCT.

This is required under three viewpoints:

- technical,
- organizational, and
- legislative.

Technically speaking, this allows each organization managing an SCT’s node to maintain and upgrade its own hardware and software systems according to its technical needs, once SCT functional requirements are satisfied.

From the organizational point of view, this means data and metadata remains (and are managed by) directly under the control of each organization owning them. This is important, since to avoid that an organization feels itself deprived of the control over its own data is a critical issue to

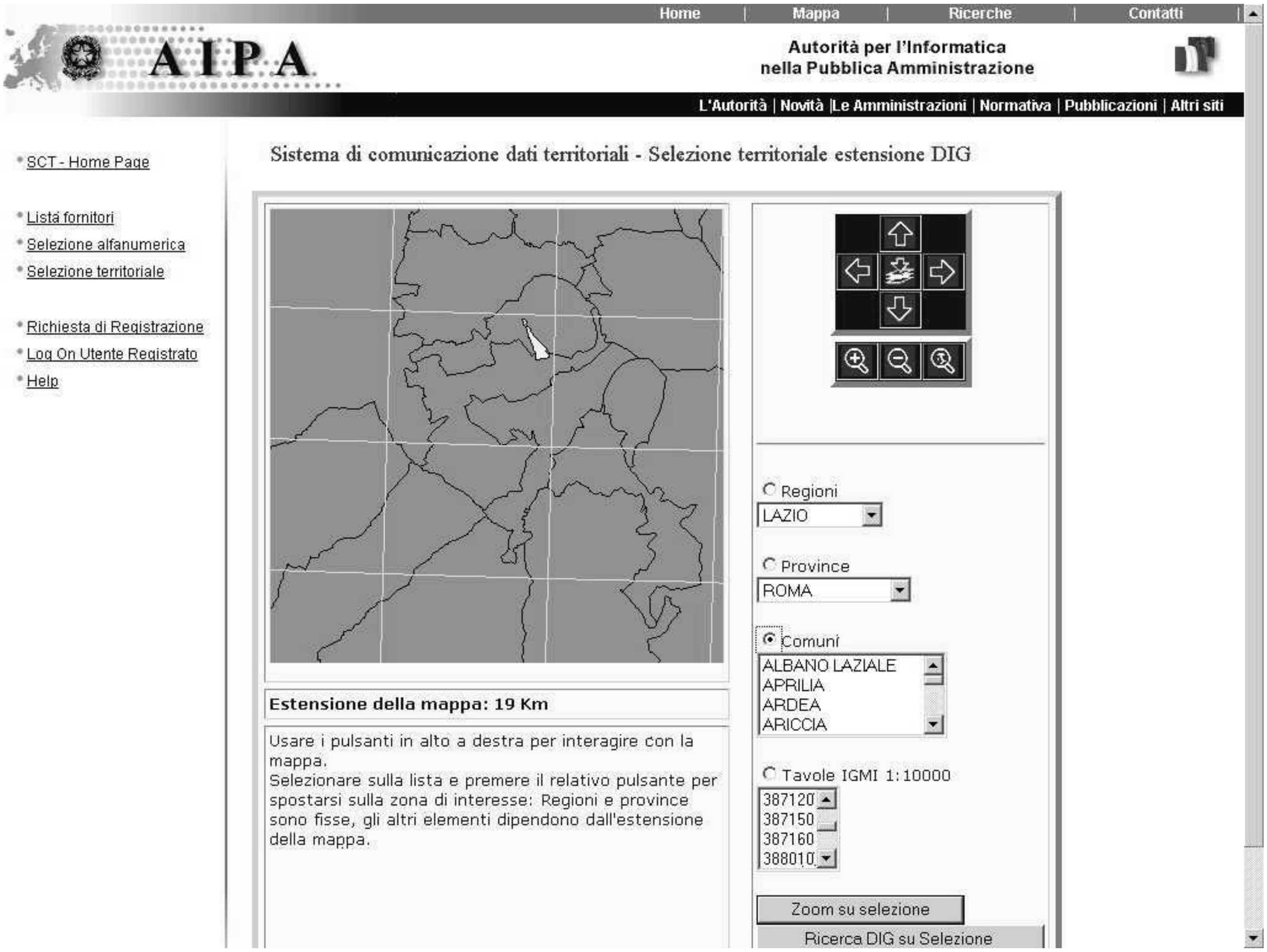

Figure 4. An intermediate DIG selection step

ensure the success of every cooperative IT-system development effort. It is moreover the best choice to leave specific data to organizations having a long standing experience of their management.

Finally, from the normative viewpoint it is important data remains under the direct responsibility of those organizations that, according to the law, have the power of certifying their content. For example, in Italy, laws assign to the Ministry of Finance the task of certifying boundaries of real estates.

But it is also important that the overall SCT architecture ensures to end-users unified description and access mechanisms to territorial data ensured to end-users by the overall SCT architecture. In this way, independently from the physical location and distribution of required data, an end-user can, through a single search process, investigate availability and the degree of matching of existing territorial data to its needs.

It is therefore clear that only a suitably defined infrastructure, according to the approach showed by SCT, is able to guarantee reliability, flexibility, extensibility, homogeneity, and maintainability of the whole set of services.

From an organizational point of view, to be able to guarantee a correct functional inter-operability of the various nodes, it is needed an infrastructure for control and certification of services with the following requirements:

- to guarantee to each provider or end-user of services a full control over the modalities of supply of or access to services;
- to ensure a full independence of the service from the specific hardware and software technologies used by providers and end-users;

- to be able to quickly add new services.

SCT's Managing Agency has therefore to have at least the following organizational units:

- a *coordination committee*, defining and updating policies, standards, procedures, and organization modalities for the services of publication and supplying of territorial data. It also have to control quality of services supplied by SCT and the degree of satisfaction from all its users. Such a committee has representatives from central and local organizations of Public Administration, from industry, from research and from private citizens. Its also has representatives from the two further committees below described.
- a *metadata working committee*, responsible for the definition, control, and update of metadata. Such a committee is formed by various technical experts (e.g., for cartography, informatics, telematics, administration, ...) and has the main task of validating metadata prepared by each organization wishing to become a node of SCT before their insertion in SCT' metadata base.
- a *technical operation committee*, with the main task of controlling and managing the technical infrastructure of SCT, both for the central node and for the connections with the various distributed nodes.

5 Towards a full support for inter-organization cooperation

SCT can be considered a first preliminary example, in the sector of Geographical Information System, of a system supporting inter-organization cooperation. In the more focused domain of cadastral data, we have realized a working system ("Sistema d'Interscambio Catasto-Comuni", described in [2]) as an implementation of the general approach to inter-organization cooperation, named *Access Keys Warehouse* (AKW) and described in [1].

A further example of the application of the AKW approach to define and realize a cooperative information system is "Sistema Informativo della Montagna" (SIM - described in [4]). SIM is an IT system providing e-government services to citizens living in mountain areas in the following sectors: cadaster, labour and pension, and public registries of personal data.

The most critical issue to solve for realizing IT-based system supporting inter-organization cooperation is how to manage the overall (distributed) coherence of data. In fact, each organization involved in cooperation needs data produced and managed outside the organization itself. Then it creates its own copy of such data, which unfortunately becomes more and more obsolete, since to keep them constantly up-to-date is an expensive task. This (distributed) incoherence is the main obstacle to implement efficient IT systems supporting inter-organization cooperation. In fact, human beings can overcome small mismatches in data representation, due to their intelligence, but current IT systems are far beyond from being as smart as them.

The AKW approach we have proposed in [1] and discussed in a real-life application example in [2] offers a methodological guidance for this objective. Briefly speaking, it suggests to set-up a warehouse containing a suitably defined set of access keys to data in the various IT systems of organizations involved in the cooperation. Therefore such a warehouse provides the means to access to and to keep synchronized representations of the same object of the reality of interest in various organization. Of course the first materialization of such a warehouse is a large organizational effort, but AKW approach allows to develop it in an incremental (and easier to control) way. A formal model for AKW is described in [5].

In the case of territorial data, their description mechanism implemented in SCT by means of metadata (DIGs) offers a natural tool to implement an Access Keys Warehouse. By their nature and due to the absolute reference coordinate system offered by the geometric space, DIGs allow SCT end-users to discover and establish a correspondence between territorial data referring to the same characteristics of the reality of interest (e.g. a local districts partition of a city for the purposes of taxation levels). Once this correlation is recorded in SCT, the same kind of mechanisms currently supporting exchange services allows to implement coherence maintenance activities. In such a way the infrastructure to keep under control alignment among various representation is set-up: this of course does not imply the representation internal to an organization is automatically changed by initiative of SCT, but that a signal is activated and an incoherence flag is raised. Rules contained in the organizational policy agreed by all organizations involved in the cooperation will then prescribe steps to be taken to re-establish coherence among the various representations.

6 Conclusions

We have presented and discussed in this paper SCT ("Sistema di Comunicazione di dati Territoriali") a prototype designed and implemented in Italy in an effort, coordinated by the italian Authority for Informatics in Public Administration (AIPA), to foster the development of a market for territorial data, mainly for the public sector but also for the private one. Results of further AIPA's efforts in this area are described in [1, 2, 4, 5].

SCT pursues its target by means of an innovative approach featuring a unified model for:

- data publishing,
- selection of relevant data for end-users,
- cost-benefit analysis,
- data supply from providers to end-users.

In such a way SCT overcomes and solves current problems currently limiting a widely adoption of data distribution mechanism for geographical information systems in the public sector, namely:

- lack of functions for selecting data really relevant to end-users,
- low support for evaluating data quality,
- hard to evaluate cost-benefit analysis for reuse,
- scarce control on telematic data supply.

Due to these problems it has many times happened in the past that data supply agreements of episodic nature have distortedly become reference for the market.

For these characteristics SCT therefore constitutes a natural mediating "virtual place" between territorial data providers and users and offers the means to define and enforce a public policy in the sector of territorial data exchange.

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