IDE-E: Technological advances for a Web-based National Spatial Data Infrastructure, convergence with the European initiative INSPIRE TIC2003-09365-C02

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Abstract

INSPIRE is an initiative for a European directive to create a Spatial Data Infrastructure (SDI) al the European level, its objective is to facilitate the access to spatial data, information which is recognized of vital importance mainly in the environmental sector. The development of such SDI involves many technological problems mainly related with interoperable geoprocessing and related areas. This project, which is the continuation of a previous project, joins together the efforts of the research groups working in this area to provide inside and gain experience. The result indicators show that the activities of the R&D groups involved in the project have contributed in a significant way to the advance of the technology and the implantation of the Spatial Data Infrastructure of Spain.

Keywords: OGC, Java, Catalogs, Catalog Services, Metadata, Thesaurus, Geographic Information, GIS, Web Services, Geoprocessing Services, Web Map Servers, Interoperability, Distributed Objects, Spatial Data Infrastructures, Open Standards

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1.   **Project objectives**

The project has a goal of technological advancement toward the construction of a Spatial Data Infrastructure (SDI) in Spain making possible the development of national technology in this field. SDI can be seen as a tool to facilitate the access and exploitation of key spatial information for a long list of applications, mainly in the public sector. From the technological point of view, a SDI consists of reference geographic data, metadata, and diverse web services (standard and interoperable), especially access via catalogs, that allow that users (scientists, public sector technicians, general public) are able to locate and access these data and their value-added products. Many challenging technological problems arise to deal with SDI in areas such as distributed geoprocessing, technological and semantic interoperability, open geoprocessing services and standards, web services and architectures, information recovery, metadata, geodata models, geodata harmonization, … A previous project served to overcome the previous lack of SDI development at national level and produced technology which has been successfully put into practice in several projects which are operational. The technological position we have reached with the previous project imposes us now to follow the research a variety of aspects which may and must be improved, as much for the inclusion of new ideas, as to solve problems found and to take advantage of new possibilities open by other technologies.

A key development now underscores the need for advancement in this line of R+D: in November 2001 the European Commission launched INSPIRE (INfrastructure for SPatial InfoRmation in Europe), an initiative to create European legislation to guide national and regional SDI development, initiative that is at the co-decision process (Commission/Parliament) and is expected to become directive by 2.006. This initiative, sponsored at the highest levels within the EC, (see Memorandum of Understanding for the cooperation between Commission services Directorate General of Environment, EUROSTAT and Directorate General of the Join Research Center), will mandate how and when each member state should create its national SDI. We must also add at this time, the convergence between different standardization organizations in the field of geographic information (OGC, ISO, CEN, FGDC, …), institutions (GSDI, EUROGI, AGILE, JRC, …) and European initiatives (GETIS, GINIE, INSPIRE, …). Inside the Spanish framework, AENOR is trying to converge geographic standards, and the Consejo Superior Geográfico (Commission of Geomatics) which is in charge of the development of the National Spatial Data Infrastructure in Spain. This convergence of interests allows functionalities which make profit of the new communication technologies (mainly through the web) and demands important advances in the technological and also semantic interoperability in the domain of spatial information. Although it has been a large advance in the software technology for the manipulation of geographic information, the creation of this new infrastructures and the conformity with new standards needs the development of new technology.

Introduction to INSPIRE

Good policy depends on high-quality information and informed public participation. Policymakers have recognized the growing interconnection and complexity of the issues affecting the quality of life today, and this recognition is influencing the way new policies are now being formulated. A new approach is therefore needed to deal with monitoring and reporting and with data management and delivery across the different levels of government. Policies need to be employed to reduce duplicated data collection and to assist and promote the harmonisation, broad dissemination and use of data. Such policies should result in increased efficiency, the benefits of which can be reinvested in improving the availability and quality of information. In turn, the increased availability of information will stimulate innovation among information providers in the commercial sector.

Spatial information can play a special role in this new approach because it allows information to be integrated from a variety of disciplines for a variety of uses. A coherent and widely accessible spatial description of the Community territory would deliver the requisite framework for coordinating information delivery and monitoring across the Community. Spatial information may also be used to produce maps, which are a good way of communicating with the public. Unfortunately, the technical and socio-economic characteristics of spatial information make the problems of coordination, information gaps, undefined quality and barriers to accessing and using the information particularly acute.

The Commission has therefore decided to submit to the European Parliament and the Council of the European Union the INSPIRE proposal to make interoperable spatial information readily available in support of both national and Community policy and to enable the public to access to this information. This initiative derives from the commitment of several Commission services in particular DG Environment, Eurostat and the Joint Research Centre.

The proposed Directive creates a legal framework for the establishment and operation of an Infrastructure for Spatial Information in Europe, for the purpose of formulating, implementing, monitoring and evaluating Community policies at all levels and providing public information. A key objective of INSPIRE is to make more and better spatial data available for Community policy-making and implementation of Community policies in the Member States at all levels. INSPIRE focuses on environmental policy but is open for use by and future extension to other sectors such as agriculture, transport and energy. The proposal focuses specifically on information needed in order to monitor and improve the state of the environment, including air, water, soil and the natural landscape. Much of this information needs to be underpinned by "multi-purpose" spatial data. INSPIRE is designed to optimize the scope for exploiting the data that are already available, by requiring the documentation of existing spatial data, the implementation of services aimed at rendering the spatial data more accessible and interoperable and by dealing with obstacles to the use of the spatial data.

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Objectives of the project

For the technology to be developed to be truly useful, it should follow international standards and be developed using the latest innovative methodologies; for this reason this project proposes to continue following the progress of (and participation in) these INSPIRE-related initiatives, especially in areas such as metadata, information retrieval, multilingual access, interoperability and the semantic web. Within the realm of technology creation the project will follow and develop innovative architectural frameworks that are optimal for web-based systems (web services) and will advance in the area of metadata creation and management. Certain key components (services) for SDIs will be implemented or improved (OGC specifications: Catalog, WFS, WCS, WTS, SLD y Gazetteers) with a focus on their interoperability with 3rd party services. Also to be explored are new manners of implementing service chaining of heterogeneous web services, access to geographic information from wireless terminals, and e-Commerce aspects of geographic information delivery. The development will focus on two areas: 1) in the area of SDI, specific functionality will be built to support needs of the administration, with emphasis on access via catalogs, and 2) in the area of the environment, the initial focus area of INSPIRE, a wide range of software tools will be created to support the needs of the collaborating public organizations, mostly from the environmental sector. This technology will be linked to information content and demonstrated within a pilot project, allowing access to key geographic information by participating administrations and businesses. Finally, the project continues on-going labors of dissemination and technology and knowledge transfer to administrations and businesses, to raise awareness of the new possibilities afforded by SDIs.

To reach that we propose to split in the following subobjectives:

1. Tracking of standardization processes and technology watching. For the technology to be useful, it is necessary its conformity with international standards and make use of the new technological possibilities, to do that a tracking, including the participation, of the standardization processes and technology watching in topics such as metadata, modeling, advanced access and information recovery services, multilingual access, web services, interoperability or semantic web.
2. Technological improvements in the architecture and basic components of metadata and catalogue. Specialized architectural patterns will be proposed for this type of computation in web and advances will be made in the software infrastructures to facilitate the creation and management of metadata and catalogue services of data sets and services catalogue.
3. Tecnolgogical improvements in software components of visualization and access services. Technological and functional improvements will be made, or will be developed if needed, in middleware software components in the SDI sector to support web services for WMS, WFS, WCS, SLD and Gazetteers.
4. Tentative exploitation of new possibilities such as service chaining, wireless equipment and e-commerce of geographic information services.
5. Creation of specific application software in two sectors: public catalogue services at the national level and environmental information

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6. Put in practice the technological and functional improvements in a pilot project to prove and demonstrate the technology to interested institutions and companies.
7. Diffusion, awareness and technology transfer.

The means needed to get these objectives are mainly related with:
- human resources, in addition to the research personal technical people is needed to be able to deal with important technical work
- computer infrastructures (servers and personal computers, and networks)
- software, some commercial (oracle, ArcGis, …) some self made

The work to achieve the previously mentioned objectives is structured into seven activities according to the following timetable:

Activity	First year	Second year	Third year
1. Project management and coordination	/ / / / / / / / / /	/ / / / / / / / / /	/ / / / / / / / / / / /
2. Standards and technology tracking	/ / / / / / / / / /	/ / / / / / / / / /	/ / / / / / / / / / / /
3. Metadata and catalogue improvement	/ / / / / / / / / /	/ / / / / / / / / /	/// / / / / / / / / / /
4. Web services development	/ / / / / / / / / /	/ / / / / / / / / /	/// / / / / / / / / / /
5. Technological and functional exploitation	/ / / / / / / / / / /	/ / / / / / / / / / /	/ / / / / / / / / / / /
6. Pilot Project	/ / / / / / / / / /	/ / / / / / / / / /	/ / / / / / / / / / / /
7. Diffusion and technology transfer	/ / / / / / / / / / /	/ / / / / / / / / /	/ / / / / / / / / / / /

2. Success level reached in the project

So far we are satisfied with the success level reached in the project.
- Metadata. Advances have been done in aggregation and derivation concepts, crosswalks for interoperability between metadata standards, the use of disambiguated thesauri to improve information retrieval. A book recently published by Springer and written by members of the projects is mostly devoted to these topics. A new ontology service has been proposed and developed. Some work has also been done with multilingual thesaurus and supporting tools. Specialized metadata profiles have been also proposed for Dublin core, inspire and the water framework directive.
- Metadata tool. The tool has been improved with several new features and provided as open source. The tool has been selected as the reference metadata tool by the Spanish SDI, Poland SDI and have been contracted by EUROSTAT. At this moment we have collaboration agreements for multilingual support in 9 languages.

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- Catalogue services. Much work has been done in at different areas such as indexing (textual and spatial), incorporation of aggregations, support for OGC standards, multilingual support, multi metadata profile support (using DC as a kernel) for the incorporation of other types of resources.
- Other web geodata services. Improvements has been done in several web servers: Map Server, Gazetteer server, route server
- Pilot project. The pilot project that has been established consists in the development of a Spatial Data Infrastructure (SDI) to support access to geographic information resources concerned with the Water Framework Directive within an inter-administration and cross-border scenario that involves: two countries, France and Spain; and, the two main river basin districts at both sides of the border, the Adour-Garonne basin district, managed by the Water Agency for the Adour-Garonne River Basins ("L'Agence de l'Eau Adour-Garonne") and the Ebro river basin district, managed by the Ebro River Basin Authority ("Confederación Hidrográfica del Ebro"). This pilot is more challenging than the one originally planned, and is co financed by the European Commission through EUROSTAT.
- Standardization. We continue our participation on standardization processes and as a result of this experience we have been working with the OGC (Open Geospatial Consortium) and we have been collaborating in the definition of the metadata profile which has been adopted for the Spanish spatial data infrastructure as well as with the Spanish gazetteer model recently adopted.
- Technology transfer. This is a very important part of our research strategy and it is our feedback mechanism and a objective demonstration of our results and, as it can be seen in section 3, we are already having clear success on that.
- Diffusion and knowledge transfer. We have already been participating in many actions as conferences or web portal. Several related courses has been designed at the general, bachelor and PhD levels (see section 3 for details). We have organized in Zaragoza the first workshop of the Spanish Spatial Data Infrastructure (280 participants) and we will be also organizing the second by the Madrid subproject. We also have an important presence in the Working Group for the Development of the Spanish Spatial Data Infrastructure organized by the Comisión de Geomática of the Consejo Superior Geográfico.

Just one, but important, difficulty has arisen in the development of the project which has been the low budget awarded. We have received 6 times less than the budget in the proposal (several demands to improve this situation were not accepted, neither renunciations). As a way of comparison, a previous subproject with 5 ejc (equivalent to full time persons) was awarded with about 132.000 € whereas this one with 23 (13,5 researchers and 10 others) ejc has been awarded with 72.000 € for the 3 years. As it can be easily understood this limitation could have produced a significant drawback for the project. The solution so far has been to use money from other sources.

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3. Result indicators

The research work undertaken in this project became reality in a variety of ways as techniques, processes, methodologies, models, architectures, concepts, software components, systems, papers, projects, courses, … We will focus below in some objective indicators:

3.1. PhD Thesis

Three PhD thesis have been finished during this project, two of them awarded with the PhD extraordinary prize, the other one pending (just defended last July 21th).

1. *Contributions on the problem of collections, interoperability and information retrieval of geographic information metadata for Spatial Data Infrastructures*. PhD student: Javier Nogueras Iso. PhD advisors: Pedro R. Muro Medrano y F. Javier Zarazaga Soria. PhD program: Systems Engineering and Computer Science. Title: PhD in Computer Science, University: University of Zaragoza, Calification: Pass Cum Laude and PhD extraordinary prize of the University of Zaragoza. Date: September 1, 2004

2. *Arquitecturas y patrones de diseño para el modelado e integración de sistemas de información heterogéneos. Una aproximación aplicada al contexto de los servicios basados en la localización*. PhD student: Pedro Javier Álvarez Pérez-Aradros. PhD advisors: Pedro R. Muro Medrano y Jose A. Bañares Bañares. PhD program: Systems Engineering and Computer Science. Title: PhD in Computer Science . University: University of Zaragoza. Calification: Pass Cum Laude and PhD extraordinary prize of the University of Zaragoza. Date: March 8, 2004

3. *Contributions to the Generation and Representation of Digital Terrain Models*. PhD student: José Poveda Albadalejo. PhD advisor: Michael Gould Carlson. PhD program: Advanced Informatic Methods. Title: PhD in Computer Science. University: University Jaume I. Calification: Pass Cum Laude. Date: July 21, 2005

3.2. Publications

The following list of books and papers present results directly related with this project (see bibliography for full references).

3.2.1. Books

[1]

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3.2.2. Journals and book chapters

[2],[3],[4],[5],[6],[7],[8],[9],[10],[11]

3.2.3. Conference contributions

[12],[13],[14],[15],[16],[17],[18],[19],[20],[21],[22],[23],[24],[25],[26],[27],[28],[29],[30],
[31],[32],[33],[34],[35],[36],[37],[38],[39],[40],[41],[42],[43],[44],[45],[46],[47],[48],[49],[50]

3.3. Projects

All the research and development projects we are involved are related with the topics in project
TIC2003-09365-C02, we list above live projects during the life time of project TIC2003-
09365-C02 so far.

3.3.1. European R&D Projects

1) AWARE: A tool for monitoring and forecasting available water resources in mountain
    environment (FP6-Space-1, proposal 12257). Sponsored by DG H. Transport and Space.
    European Union. University Jaume I. 2005-2007.

2) SDIGER: A cross-border inter-administration Spatial Data Infrastructure to support WFD
    information access for Adour-Garonne and Ebro River Basins. Consulting and Technical
    Assistance Contract. Sponsored by EUROSTAT, Invitation to Tender (2004/S 111-
    092104/EN), Pilot projects on the implementation of the Infrastructure for Spatial
    Information in Europe (INSPIRE). Participant entities: IGN (France), IGN FI, University
    of Zaragoza (coordination of Spanish part), CNIG. 2004-2006.

3) ACE-GIS: Adaptable and Composable E-commerce and Geographic Information Services.
    (Ref. IST-2001-37724). Sponsored by IST Program, European Union. Norwegian
    Mapping Agency and University Jaume I 2002-2004.

4) TOWNTOLOGY: Urban Ontologies for an improved communication in Urban Civil
    Engineering Projects. European Cooperation in the field of Scientific and Technical
    Research - COST – Secretariat. European Concerted Research Action COST Action C21.
    2005-2008

5) EUSC-IDSS Symbol schema concept and symbol design and test of symbol schema
    implementation. Consulting and Technical Assistance Contract. Sponsored by European
    Union Satellite Centre (EUSC) subcontracted by Open GIS Consortium (Europe) Limited
    (OGCE) (Ref. EUSC-RF-Ph1+2-PMM). 2004.

6) ESA Harmony. Consultancy Agreement. Sponsored by ESA (European Space Agency).
    University of Zaragoza subcontracted by OGCE (Open Geospatial Consortium Europe)
    (Nr. ESA Harmony-PMM-2005-01, OGCE Job Code "ESA Harmony 20013"). 2005.

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7) Collaboration Agreement in the area of the Spatial Data Infrastructures (SDI). Collaboration Agreement. Sponsored by Environment and Sustainability Institute of the Joint Research Centre (JRC) of the European Community and University of Zaragoza. 2005-2010.

3.3.2. National projects and R&D activities sponsored by public calls

1) On line access to the Resources Catalogue of Geographic Information of the University of Zaragoza. Sponsored by Aragón Government, Department of Science, Technology and Universities, Directorate General of Technologies for the Information Society. Ref. 52/2004. 2004.

2) Development of digital contents of historic artistic buildings of Zaragoza and publication in Internet. Sponsored by Aragón Government, Department of Science, Technology and Universities, Directorate General of Technologies for the Information Society. Ref. 158/2004. 2004.

3) Mobil access to field service module with geographic localization. Sponsored by Ministry of Industry, Commerce and Tourism, project Profit FIT-350100-2004-367 (National Program of Technologies of Services for the Information Society) Participant entities: Insynergy Consulting España, S.L. and University of Zaragoza. 2004.

4) IDE-E: Technological advances for a National Spatial Data Infrastructure based on Web, convergence with the European initiative INSPIRE. Sponsored by Ministry of Science and Technology, coordinate project, ref.: TIC2003-09365-C02-01Participant entities: Polytechnic University of Madrid, coordination: University of Zaragoza. 2003-2005.

5) Implementation of Environmental data infrastructures (IMD): Prototype of application of geographical information systems to hydric resources management. Sponsored by Fundació Bancaixa Castelló. UJI. 2002-2005.

6) Virtual interaction technologies with set of stocked objects of high cardinal. Application to container depot and storage centres. Sponsored by MCYT. University Jaume I. 2002-2005.

3.3.3. Projects for management of R&D activities sponsored by public calls

1) Consolidated research group – Advanced Information Systems Lab. Sponsored by Aragón Government, Department of Education and Science. Directorate General of High Education (attendance to support Operative Units of Research of the Autonomous Community of Aragón ref T56) 2005.

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2) Creación de un Laboratorio de Tecnologías de la Información Espacial. Sponsored by Dirección General del Instituto Geográfico Nacional, Ministerio de Fomento, UPM. 2005 (renovable anualmente). 144.000 Euro/año.

3) Thematic Network of Geographic Information Technologies. Sponsored by Ministry of Education and Science, Complementary Actions in the framework of some National Programs of the National Plan of Scientific Research, Development and Technological Innovation 2004-2007 (ref. TSI2004-20019-E). Participant entities: National Geographic Institute¡ and the Universities Castilla la Mancha, A Coruña, Jaume I, Polytechnics of Madrid, Santiago de Compostela, Sevilla and Zaragoza. Coordinated by the University of Zaragoza. 2005

4) Emergent research group – Advanced Information Systems Lab. Sponsored by Aragón Government, Department of Education and Science. Directorate General of High Education (attendance to support Operative Units of Research of the Autonomous Community of Aragón) 2004.

3.3.4. Projects and R&D activities with companies and/or administrations

1) Trophy state evaluation of main water reservoir of the Ebro basin by spatial teledetection techniques. Technical Assistance Contract. Sponsored by Ebro River Basin Authority (Ref. 2005-PH-18-I). 2005

2) Report server system improvement and extension. Technical Assistance Contract. Sponsored by Ebro River Basin Authority (Ref. CHE 2004-PH-40-I). 2005

3) IPA Data Base migration, improvement and exploitation. Technical Assistance Contract. Sponsored by Ebro River Basin Authority (Ref. CHE 2004-PH-40-I). 2005.

4) Optimization and extension of the Spanish Spatial Data Infrastructure Portal and the National Geographic Institute clearing house of data and geographic services. Collaboration Agreement. National Geographic Institute, Ministry of Public Works. 2005.

5) Complementary development of technology and methodology of metadata capture of geographic information of the Spatial Data Infrastructure of Spain and the node of the National Geographic Institute clearing house of data and geographic services. Collaboration Agreement. National Geographic Institute, Ministry of Public Works. University of Zaragoza y Polytechnic University of Madrid. 2005.

6) Armonización planimétrica de ortofotos con su cartografía catastral. Sponsored by Dirección General del Catastro, Ministerio de Hacienda, UPM. 2004-2005 (prorrogable por años). 68.000 €.

7) Planimetric harmonization of orthophotos with their cadastral cartography. Sponsored by Dirección General del Catastro, Ministerio de Hacienda. University Polytechnic of Madrid. 2004-2005. 68.000 €/year

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8) Open software busissnes strategic study. Sponsored by IVER Tecnologías de la Información, S.A. (Valencia). University Jaume I. 2004-2005.

9) Participation and support software for the Project 04/160 Implementation services of an open server of catalogues. Consulting and Technical Assistance Contract. Sponsored by Generalitat Valenciana. University of Zaragoza subcontracted by the Jaume I University of Castellón. 2004-2005.

10) Services towards the implementaron of a Catalog Open Server. Sponsored by Conselleria de Infraestructuras y Transporte, Generalitat Valenciana. University Jaume I. 2004-2005.

11) Definition and implementation of a protocol of creation of metadata as support of a spatial data infrastructure for the Conselleria of Infrastructure and transport. Sponsored by Conselleria de Infraestructuras y Transporte, Generalitat Valenciana (Ref.:CONMEN/2004/01). University Jaume I. 2004.

12) Two conferences held in the International Geocycle of Conferences. Sponsored by AENA. University Polytechnic of Madrid. 2004. 6000€.

13) Technical assistance for the preparation of an analysis for the establishment of a tourism model based on new technologies. Consulting and Technical Assistance Contract. Sponsored by Aragón Government, Directorate General of Technologies for the Information Society. Digital Cities Program. 2004.

14) Viability study for the establishment of an SDI node for the Ebro River Basin Authority. Consulting and Technical Assistance Contract. Sponsored by Ebro River Basin Authority,)Ref. CHE 2004-PH-40-I) 2004.

15) Creation of a Spatial Information Technology Laboratory. National Geographic Institute, Ministry of Public Works. University Polytechnic of Madrid. 2004. 114.000€/year.

16) Implementation of query, quality control and data visualization functionalities in the Quimipa software application. Consulting and Technical Assistance Contract. Sponsored by Ebro River Basin Authority, (Ref. 2004-PH-35-I). 2004-2004.

17) Architectural, interoperability, modelling aspects and other R&D topics of information technologies in the software development for the integral management of hospitals and geriatric centres. Consulting and Technical Assistance Contract. Sponsored by Savac Consultores S.L. 2004-2006.

18) Integration of geographic information for the management of financial aids of the Communitarian Agrarian Policy. Consulting and Technical Assistance Contract. Sponsored by Sociedad de Infraestructuras Rurales Aragonesas, S.A., SIRASA, for the Diputación General de Aragón, Department of Agriculture. 2004-2005.

19) Storage, verification and assurance of the geometric correspondence of aerial images of Aragón, Phase II. Consulting and Technical Assistance Contract. Diputación General de Aragón, Department of Agriculture. 2004.

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20) Support Works to attend the requirements derived from the Water Framework Directive in the topics of Hydrologic Planning (Ebro River Basin). Consulting and Technical Assistance Contract. Sponsored by Ministerio de Medio Ambiente, Ebro River Basin Authority. University of Zaragoza subcontracted by Zeta-Amaltea. 2004-2006.

21) Search applications with NEM metadata for geographic information catalogue services for the SDI-GV. Consulting and Technical Assistance Contract. Sponsored by Generalitat Valenciana, Consellería of Infrastructures and Transport and Valencia Cartographic Institute. 2004.

22) Cartographic information visualization tool for aqueduct. Consulting and Technical Assistance Contract. Sponsored by Berta Bescós Roy. 2004.

23) Geographic Information Catalogue Services for the SDI-GV. Consulting and Technical Assistance Contract. Sponsored by Generalitat Valenciana, Consellería of Infrastructures and Transport and Valencia Cartographic Institute. 2004.

24) Spatial Calculus application for windmills. R&D contract. Sponsored by Iberinco. 2004.

25) Analysis of the information systems of the Area of Water Quality and performance proposal. Consulting and Technical Assistance Contract. Sponsored by CHE, Comisaría, Area of Water Quality. 2004.

26) Evaluation of the modellization of the Integral Management of a Hydrographic Basin, HIDROSIS. Consulting Contract. Sponsored by AENOR. 2004.

27) Cartographic and plan information visualization tool for the Nerja Almuñecar highway. Consulting and Technical Assistance Contract. Sponsored by Berta Bescós Roy. 2004.

28) Interoperable software components for a route and map server in a web and PDA environment. R&D contract. Sponsored by RACC, subcontracted by Net2U. 2004.

29) Design of the evolution towards a Spatial Data Infrastructure in the Zaragoza local area, IDEZar. Collaboration Agreement. Sponsored by Zaragoza Council, Concejalía of Science and Technology. 2003-2004.

30) Software environment for the storage of Hydrogeochemistry information. The Quimipa application. Consulting and Technical Assistance Contract. Sponsored by Ebro River Basin Authority, Hydrographic Planning Office. 2003-2004

31) Actualization and improvements in the IPA information system. Consulting and Technical Assistance Contract. Sponsored by Ebro River Basin Authority. 2003-2004.

32) Definition and implementation of mechanisms for the Internet remote access to IPA. Consulting and Technical Assistance Contract. Sponsored by Ebro River Basin Authority. 2003-2004.

33) Creation of the web portal of the Spanish Spatial Data Infrastructure and the node of the National Geographic Institute for distribution and intermediation of geographic data and

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services. Collaboration Agreement. Sponsored by National Geographic Institute, Ministry of Infrastructures. 2003-2005.

34) Creation of web services for route optimization based in open standards for the RACC portal. Consulting and Technical Assistance Contract. Sponsored by Net2U. 2003-2004.

35) Development of the Environment and Geographic Information Network of Galicia. Cooperation Agreement. Xunta de Galicia, Conselleria of Environment. Entities participants: Teide Consortium (University of Zaragoza, Jaume I University, Polytechnic University of Madrid), responsible University of Zaragoza. 2003-2004.

3.4. Education and knowledge transfer

Only activities sponsored by public calls.

1) eduGILA. Sponsored by ALFA program, European Union. University Jaume I. 2003-2004.

2) Spatial Data Infrastructure of Spain (IDE-E). Course for the installation of Web Map Servers (WMS) and Object Servers (WFS), in conformance with OGC spedifications using Open Source. Sponsored by Ministerio de Fomento. 2004. 8.000 €

3) VideoConference infrastructure to give classes of Doctorate courses: Geoinformation for Government and Society. Sponsored by UPM. 2005. 4.500 €

4) Establishment of a PhD join program on Geoinformation for Government and Society. Sponsored by AECI. 2005. 12.000 €

5) LIFE-TIERMES. Support to IDE creation and courses about archeologic topography. Sponsored by LIFE project, Tiermes Museum Friends Association. University Polytechnic of Madrid. 2005. 12.000€.

3.5. Diffusion

Only activities sponsored by public calls.

1) Workshop of the Spatial Data Infrastructure of Spain. Sponsored by the University of Zaragoza with financial support for the organization of Scientific Congress and Meetings. 2005.

2) Workshop of the Spatial Data Infrastructure of Spain. Sponsored by Ministry of Infrastructures (Nº Exp. 33/04. 2004). 2004

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3) JTIDEE04. Workshop of the Spatial Data Infrastructure of Spain. Sponsored by Aragón Government, Department of Science, Technology and Universities, Directorate General of Technologies for the Information Society. Ref. 157/2004. 2004.

4) Producción y distribución de un Newsletter sobre Infraestructuras de Datos Espaciales (IDE) en español complementado con difusión y entrega de materiales sobre IDE a las instituciones participantes. Sponsored by Global Spatial Data Infrastructure (GDSI). Small Grants Program, participants UNPSJB y UPM. 2005. 2.500 US$

5) Organización de dos Conferencias dentro del Geo-Ciclo Internacional de Conferencias. Sponsored by AENA (Aeropuertos Españoles y Navegación Aérea). 2004. 6.000 €

Groups of the project have organized
- 1st Workshop of the Spatial Data Insfrastructure of Spain hold in Zaragoza las November and is organizing the 2nd one that it will take place in Madrid next November.
- 1st Workshop on Geographic Information Management (Zaragoza, sept. 2004) and is organizing the 2nd that it will take place in Denmark next September.

3.6. **Experts**

3.6.1. **INSPIRE experts**

Another relevant indication of the expert knowledge got by the members of the project is that two of them have been selected as experts in the call for experts for the development of INSPIRE draft Implementing Rules (5 drafting teams of 6 members each have been selected from a total of 180 all along Europe -see **http://inspire.jrc.it/-**). An additional expert has also been selected in a support expert group (only 4 experts have been selected from Spain).

3.6.2. **WG-IDEE**

We are also participating as experts (the only in the working group for the Spatial Data Infrastructure of Spain (IDEE standing for Infraestructura de Datos Espaciales de España), a working group (of about 100 persons in representation of al institutions involved in the IDEE) established by the Comisión de Geomática del Consejo Superior Geográfico which is in charge of the development of the national SDI. Additionally we are part of the Comisión de Geomática in representation of Universities.

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