A HIGH LEVEL ARCHITECTURE FOR NATIONAL SDI: THE SPANISH CASE

Rubén Béjar[1], Pablo Gallardo[1], Michael Gould[2], Pedro R. Muro-Medrano[1], Javier Nogueras-Iso[1], F. J. Zarazaga-Soria[1]
[1]Department of Computer Science and System Engineering, University of Zaragoza, Zaragoza, Spain
[2]Department of Information Systems, University Jaume I, Castellon, Spain

ABSTRACT

The National Spatial Data Infrastructure of Spain (Infraestructura de Datos Espaciales de España, IDEE) is currently being defined and set up by the National Geographical High Board (Consejo Superior Geográfico, CSG), that is the highest consultative and planning body in Spain in the scope of cartography, through its Comission on Geomatics and by way of the Spanish NMA (Instituto Geográfico Nacional, IGN), institution that assumes the technical secretariat of the CSG and produces basic reference geodata at the national level. The IDEE project will have to facilitate the incorporation of the different SDI being developed, or at least in project, by the different Autonomous Communities (NUTS II regions) without imposing restrictions on the areas they are responsible for. This will also be the case with other spatial data infrastructures at different levels. Indeed successful SDI will need to address the problems of structuring and organizing the access to existing services, data and metadata when these services are distributed among different smaller organizations, which have different responsibilities, resources and necessities. This paper describes an architectural pattern proposed for SDI that are composed of other SDI with shared responsibilities and roles.

KEYWORDS: Spatial Data Infrastructure, Distritbuted Information System Architecture, inspire

INTRODUCTION

The National Spatial Data Infrastructure of Spain (Infraestructura de Datos Espaciales de España, IDEE) is being designed following the recommendations of the INSPIRE initiative at all levels (reference data, metadata, standards, services etc.). Indeed several subgroups have been set up in the IDEE working group of the Comission on Geomatics with a structure similar to that of the horizontal working groups of INSPIRE.

Spanish decentralized political organization, that includes distributed responsibilities on creation and maintenance of reference geographic information, has made arise the necessity to give a significant impulse on the issue of establishing an architecture for the IDEE that goes further into the idea of architecture = catalogs + metadata + web services + user applications.

It seems obvious that addressing this issue from the idea of a “plain” structure that has all services and data at the same level will work only for small infrastructures. Establishing thus the ways an SDI can be structured will be fundamental for the success of these infrastructures. This paper shows an architectural pattern for SDI that, very briefly, describes SDI in terms of *SDI-nodes, responsibilities, roles and scopes.*

Similar issues arise in geoportals: a geoportal is not an SDI, but it is a meeting point for its users, a door to the infrastructure, and the most visible part of it. Geoportals should thus be developed taking into consideration the fact that the different SDI behind them have architectural organizations, and that the geoportals should resemble that organizations. Of course geoportals will have to be structured in a way significant to the potential users of the infrastructure, in order to make it easier for them to understand and make profit of the infrastructure.

HIGH LEVEL ARCHITECTURAL PATTERN FOR SDI

From an information system point of view, SDI are distributed geographical information systems based on standards. Different SDI are supposed to work together, to reach the INSPIRE principles (i.e. public administrations with different responsibilities, thematic communities, private companies, research institutions, etc.). Isolated SDI are described with a relatively simple and relatively defined architecture [JRC, 2002], but an architecture for interacting, cooperating and interoperable SDI has not been clearly defined so far. To overcome this problem, an architectural pattern for SDI, that takes into consideration the fact that an SDI will be composed by others, is being presented in this paper. As software architectures are typically described as components and the interactions among them [Shaw and Garlan, 1996], some definitions of the components of this pattern are given, followed by a diagram that shows their relationships.

SDI-nodes: An SDI-node is defined as a part of an SDI with its own entity (normally because of being the SDI of some organization, or department of an organization). It should have some minimum requirements (at least having some data or services, some standard metadata about these data or services, a way to discover these metadata and some way to access the data and services).

Responsibilities: A responsibility is defined as a set of tasks that an SDI-node has an obligation to support or carry out. It may be a legal obligation, some collaboration agreement among participants in an SDI, a commercial contract, etc. There will be SDI-nodes without responsibilities (i.e. voluntary collaborators).

Roles: A role is defined as a name given to a subset of the responsibilities of an SDI-node. All SDI-nodes will play some role in the SDI, even a small, simple or very specialized one. Nodes without responsibilities will still have a role, an empty subset of the responsibilities of the node, maybe “voluntary collaborator”. Roles are defined for the different scopes where the SDI-node is integrated. A comprehensive list of possible roles is yet to be defined.

Scopes: A scope is defined as an area (i.e. an administrative division) for which a role of an SDI-node is defined. An SDI will have a scope (typically the area for which it intends to provide catalog, data, metadata, services etc.).

Architectural pattern for SDI

The different components described in the previous section are related among them. These relationships are shown in Figure 1, using a simple UML class diagram. The main elements are SDI and SDI-node. An SDI is shown as an abstract class, because they need to be implemented by some SDI-nodes to have a concrete reality. The diagram shows SDI-nodes as concrete classes that are SDI (is-a relationship). SDI are shown to be composed of one or more SDI-nodes (this pattern is similar to the composite design pattern [Gamma et al., 1995] but the roles of Composite and Component are somehow reversed). This way we can describe an SDI as a composition of SDI-nodes that are SDI themselves. For example, the Spanish NSDI (IDEE) would be an SDI-node in this pattern. This way, IDEE would be an SDI (an SDI-node is-a SDI, in this case it is the SDI of Spain) and also a part of a bigger SDI (i.e. the European SDI , that would be composed of many NSDI). The other relationships can be deduced from the given definitions. SDI-nodes have responsibilities, that can be grouped in roles. These roles are defined for different scopes, where the SDI-node plays them.

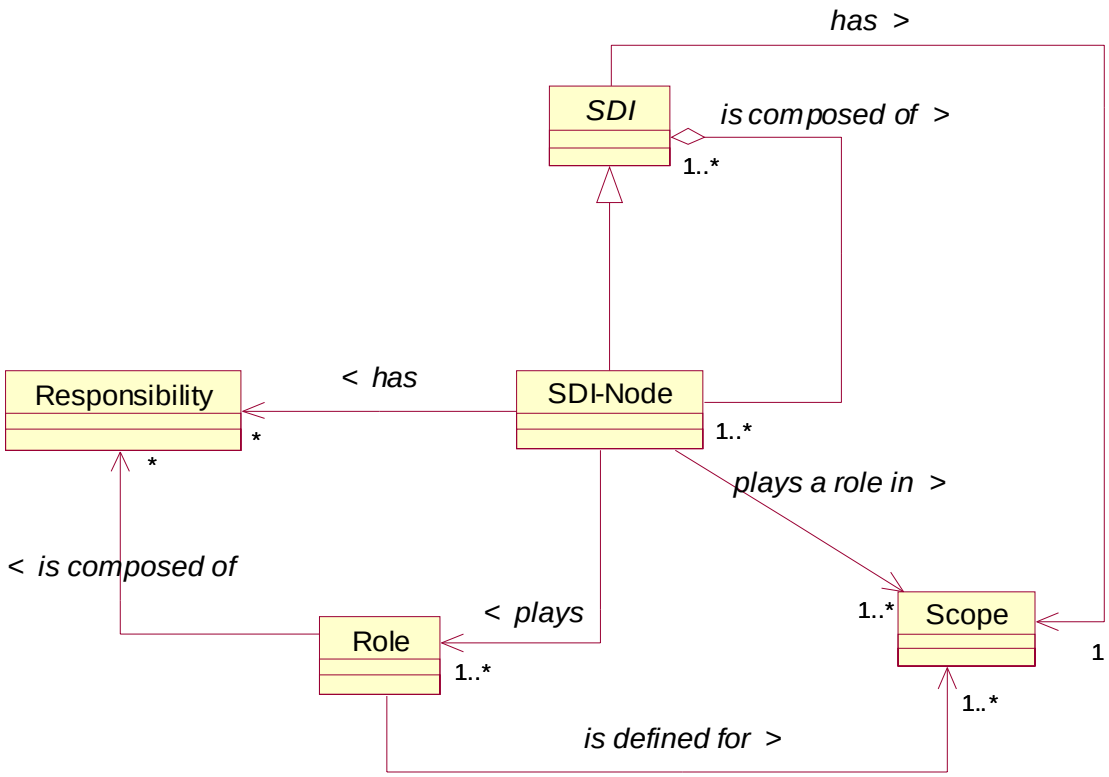

Figure 1: Architectural pattern for SDI

A couple of examples are presented now, in order to clarify the meaning of the different elements that are part of the proposed architectural pattern for SDI.

Ebro river basin district authority

The Ebro river basin district authority (Confederación Hidrográfica del Ebro, CHE) has a small SDI to fulfill their internal necessities related to visualization to geographic information and to provide some support to their website [Latre et al., 2003].

- It is an SDI-node: the SDI of the CHE.
- As it is an SDI, it has a scope: the basin of the Ebro river.
- It has some responsibilities (yet to be properly defined) : i.e. providing with the official data about water points (the water point inventory) in its scope (i.e. it doesn't need to provide water points in other basins).
- It plays some roles (yet to be properly defined): i.e. "official hydrographical information provider for its scope at scales larger than 1:200000".

IGN Node in the Spanish NSDI (IDEE)

- It is an SDI-node: the SDI of the IGN (Instituto Geográfico Nacional, the Spanish NMA).
- As it is an SDI, it has a scope: Spain.
- It has some responsibilities: i.e. providing standard web map services with topographical data up to the scale of 1:25000 in its scope.

- It plays some roles: i.e. "official topographic information provider for its scope at scales equal or smaller than 1:25000". It will play other roles in other scopes; i.e. IGN is the coordinator of the CORINE project in Spain, so it could be the "official provider of CORINE data for Spain" inside the E-SDI (different scope).

Where are the geoportals?

Geoportals are not addressed as architectural components of SDI in the shown pattern because we are trying to differentiate clearly applications from infrastructure. The proposed pattern is for SDI, and a geoportal is not an SDI, but an application, maybe an important one, but an application, that an SDI may or may not have. SDI need to be developed according to common standards and principles in order to allow interoperability, but geoportals don't need not be all the same. In fact, it is difficult to believe that different SDI, with different responsibilities, scopes and roles, in different countries, etc. will have the same necessities. In particular, their "main doors", i.e. the geoportals, will need to be substantially different: not only in issues such as guide maps, or language, elements that are typically, and easily, customizable but in deeper differences: different administrative organizations in different countries, thematic or community SDI with their own necessities, different target users (derived from the different responsibilities of the SDI) etc. This is why we don't consider a geoportal a part of an architectural pattern for SDI but an application that will have to be defined and adapted to the different SDI.

APPLYING THIS PATTERN IN THE IDEE

The architectural pattern proposed tries to clarify the position of every participant in an SDI project, in terms of their responsibilities, and roles. On one hand, knowing the responsibilities allow us to discover and fix the "obligations" of every participant, this is, suggesting everyone the minimum set of things they should do to participate in the SDI. On the other hand roles allow us to find and fill gaps, i.e. if the role of providing topographical maps of a region is not played by this region SDI, other SDI (maybe the NSDI) can assume it temporarily. This is only an organizational proposal that, in the case of Spain, needs to be presented to, discussed and agreed by all participants in the IDEE project. Anyway, some incipient ideas already exist to apply this pattern in the Spanish case. The Figure 2 shows some examples that can allow to understand the proposed pattern in the case of Spain.

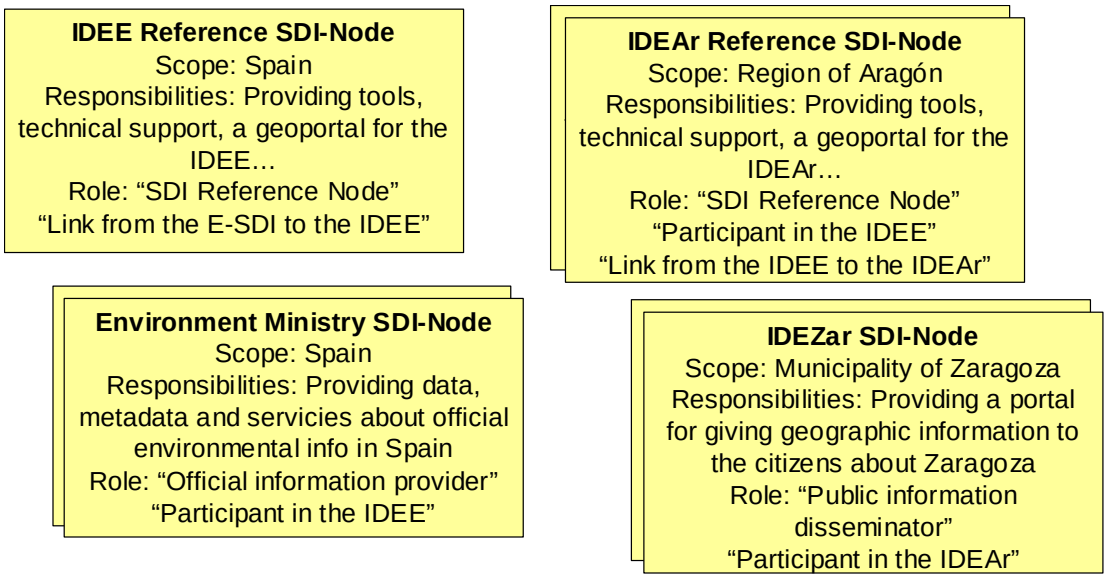

Figure 2: Some proposed SDI-nodes in the IDEE project

The previous figure shows different SDI-nodes, representative examples, that will be included in the IDEE. There will be a "reference node", that will provide some basic support to other participants (tools, documents…) and will maintain the geoportal of the IDEE. Then there will be other nodes in the national

scope, with the main role of providing information (data, services…) to the IDEE (of course, they can fulfil other roles in their organizations etc., but that will be in scope not "interesting" from the point of view of the IDEE). The autonomous regions of Spain will have their own SDI-nodes. These will be "reference nodes" in their scope, but only "regular" participants in the national scope. Local nodes are also expected, that structurally will be part of the SDIs of their regions, but indirectly also part of the IDEE.

CONCLUSIONS AND FUTURE WORK

The Spanish NSDI, IDEE, has made important progress in the last months. The geoportal (www.idee.es) was made public in June and the work groups in charge to clarify and give guidelines for standards use, organization, data harmonization etc. are working hard.

This paper has presented has shown an architectural pattern that intends to clarify the organization of SDI and the position of every participant in them. This pattern is being studied in the Spanish case, but we believe the organization and architecture of the IDEE is significant at the European level because this project has many of the challenges of the E-SDI (multiple SDI integration, cross-border issues, different official languages, different mapping agencies etc.), so the architectural solutions being proposed and adopted by this project could be studied and evaluated as possible patterns for the E-SDI itself and also for other national infrastructures.

This paper also intends to clarify, or at least make explicit, the architecture of an SDI composed of many SDI initiatives. It is a work in progress, and will have to be improved in the context of the different participants of the IDEE. Finally one should notice that this pattern offers a solution to organize SDI, but besides some kind of organization, there are still many other challenges to solve for SDI.

For the future, we will be working to improve this pattern and to apply it to the IDEE in order to discover and solve the different challenges that will appear.

ACKNOWLEDGEMENTS

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Spanish decentralized political organization, that includes distributed responsibilities on creation and maintenance of reference geographic information, has made arise the necessity to give a significant impulse on the issue of establishing an architecture for the IDEE that goes further into the idea of architecture = catalogs + metadata + web services + user applications. The IDEE project will have to facilitate the incorporation of the different SDI being developed, or at least in project, by the different Autonomous Communities (NUTS II regions) without imposing restrictions on the areas they are responsible for. This will also be the case with other spatial data infrastructures at different levels. Indeed successful SDI will need to address the problems of structuring and organizing the access to existing services, data and metadata when these services are distributed among different smaller organizations, which have different responsibilities, resources and necessities. It is understood that addressing this issue from the idea of a "plain" structure that has all services and data at the same level will work only for small infrastructures. Establishing thus the ways an SDI can be structured will be fundamental for the success of these infrastructures; the final paper will describe an architectural pattern proposed for SDI that, very briefly, includes *nodes, responsibilities* and *roles*. A node can be defined as a part of an SDI (it can be from a web map service being maintained by a laboratory in a university to a regional or even national SDI and can have its own geoportal or not). Nodes in an SDI are then organized in levels resembling the structure (i.e. relationships) of the organizations owning those nodes. The *responsibilities* include, among others, to provide data, metadata and services in their scope, properly harmonized by following the recommendations provided by the *central reference node* of the infrastructure. Finally the *roles* group responsibilities to define kinds of nodes (i.e. being a reference node).

Similar issues arise in geoportals: a geoportal is not an SDI, but it is a meeting point for its users, a door to the infrastructure, and the most visible part of it. Geoportals should thus be developed taking into consideration the fact that the different SDI behind them have architectural organizations, and that the geoportals should resemble that organizations. Of course geoportals will have to be structured in a way significant to the potential users of the infrastructure, in order to make it easier for them to understand and make profit of the infrastructure.

The final paper will present the current state of the IDEE, focusing on the way the architectural pattern proposed for this infrastructure is being applied to its reference node and geoportal. The

geoportal was presented, as a first operative prototype, to the IDEE working group of the Comission on Geomatics on February 2004, being well received, and its public release is expected by the final quarter of 2004. We believe the organization and architecture of the IDEE is significant at the European level because this project has many of the challenges of the E-SDI (multiple SDI integration, cross-border issues, different official languages, different mapping agencies etc.), so the architectural solutions being proposed and adopted by this project could be studied and evaluated as possible patterns for the E-SDI itself and also for other national infrastructures.

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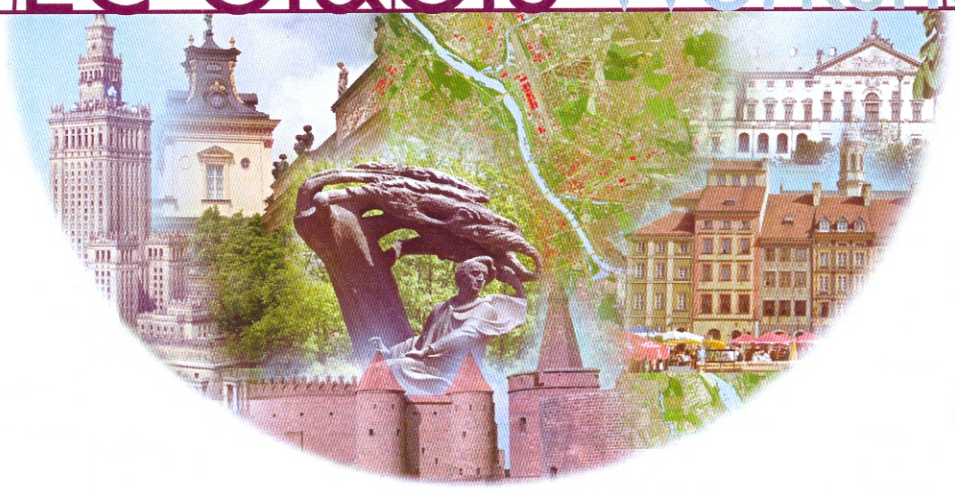

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