OGC + Open Source: The keys for the Colombian National Geographic Institute Agustin Coddazzi development of Shared Geographic Services

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Abstract

As most of the National Geographic Institutes, the Colombian National Geographic Institute Agustin Codazzi (IGAC) is a data and service provider for other public administration units that use them for achieving their goals. In order to offer enough freedom levels to these units for choosing the way and the technology for creating applications and systems, the IGAC has to base its data and service offer in the use of standards such as the ones propose by the Open Geospatial Consortium.

This paper provides an overview of a pattern model in terms OGC specification, open source technology, responsibilities, roles and scopes for building the main node of the Colombian Spatial Data Infrastructure (CSDI).

Keywords: Spatial Data Infrastructure, Open Source, OGC

1. INTRODUCTION

As most of the National Geographic Institutes, the Colombian National Geographic Institute Agustin Codazzi (IGAC) is a data and service provider for other public administration units that use them for achieving their goals. In order to offer enough freedom levels to these units for choosing the way and the technology for creating applications and systems, the IGAC has to base its data and service offer in the use of standards such as the ones propose by the Open Geospatial Consortium.

The expressions opens source refers to a group software licences that liberate the source program code, in order to give developers the opportunity for reading, redistributing and modifying the original source codes. This allows the possibility of reaching new functions reusing the software pieces that already exists. In the other hand, there is the property software developed by companies which has the unique access to the source code (Riecken 2003). They based their business strategy in the commercialization of licenses for executing the software. These products used to have a high cost for the licenses that companies justified in the compensation of the engineering work. This situation could be considered unjust because the license prices are very similar in the entire world with independence of the income per capita of the country. This is a very important limitation for the economy of an emerging country like Colombia. The use of open source is one way for improving and optimizing the limited economy resources of the Country (Craglia 2003).

This paper provides an overview of a pattern model in terms Open Geospatial Consortium (OGC) specification, open source technology, responsibilities, roles and scopes for building the main node of the Colombian Spatial Data Infrastructure (CSDI). This main node is currently being defined and set up by the Agustin Codazzi

Institute, which produces basic reference geo-data at the national level. Colombia decentralized political organization that includes distributed responsibilities on creation and maintenance of reference geo-data, has made arise the necessity to give a significant impulse on the issue of establishing a pattern model for the CSDI that goes further into the idea of architecture = catalogs + metadata + web services + user applications.

The goal of the pattern model is to provide the SDI with the capacity to accommodate new geo-data products and services according to the free market principle (Rodríguez P 2005). One of the important considerations in the design of the model is that the scientist or model developer should be immune to the details of the underlying implementation of the software or services. The model developed should be able to view the services interfaces available at the conceptual level without having to know much about the details of the implementation. At the same time, the flexibility and power of the underlying software should no be restricted when incorporated into web services. In other words, a user of the services should be able to achieve all the functionality that can be achieved by using the software in a standalone manner. The OGC web services are immune from having to learn the specifics of any one particular software package or services GIS. In the pattern model, the catalogs and service metadata are the backbone of the geo-portal which involves distributed data sources and geoprocessing services (Bennett D 1997). It shows the fundamental need to document, not only data, but also services and data sources in order to support interoperable application scenarios involving distributed geoprocessing. Also shows that 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 entities involved (OGC 2004). The pattern model also remarks two facts: national government needs in spatial data are high, but their budget is typically not so high. It is necessary to convince Colombian organizations about the benefits and opportunities of developing SDIs with open source technology.

The rest of the paper is structure as follows. Section 2 and 3 presents OGC and its specifications for geoprocessing services in a SDI. Section 4 presents open source, open source license models, and a review of open source products for SDI creation. Section 5 shows a prototype created. This work ends with a conclusions section.

2.   OGC STANDARDS

OGC does not create jure standards, it contributes to its generation. For this reason it works jointly with ISO, which really is the authority to create them. The Technical Committee 211 of ISO (ISO/TC 211) has the responsibility for creating the jure specific standards for the geomantic area. It makes its work in a short relation with OGC. In this way, there is a collaboration agreement between OGC and ISO which fix that the OGC abstract specification will become ISO/TC 211 standards, and OGC specification implementations will become ISO/TC 211 engineering specifications.
Although not all OGC specifications are going to be considered jure standards, OGC is developing a very important labour because the diffusion and general acceptance of its work by the geocommunity. Software producers dedicated to sell and distribute the GIS's components use the OGC specifications, and system integrants built their products over these specifications.

The convincement to increase the availability of the spatial data and of sharing technological developments has motivated multiple SDI projects. At local level it

could be mentioned the work realized by the United States, Thailand, Australia, and Canada. At regional level there are different initiatives to promote the interoperability of the geographic information promoted by AGEDI[1],EUROGI[2], GINIE[3], CPIDEA[4] and INSPIRE[5] that jointly have contributed to generalize some aspects of the SDIs principles. INSPIRE has a framework SDI project technology development backed up by the European Community to which the ORCHESTRA6, WIN[7], OASIS[8], GMES[9] projects have joined. This experience has made the INSPIRE architectural model one of the most concrete and simple at the SDI level. This means that there are experiences on the technological aspects to reach the interoperability that could be reused in an objective and critical form to create architectures of general use that permit the assembling of specific web services a national SDI.

3.   SERVICES FOR GEO PROCESSING IN A SDI

OGC considers a Web Service as a software component that realizes certain operations in a remote way by using and providing standardized interfaces, generally using XML as communication language. Based in this concept, OGC has built a web service architecture called OWS which has turned in to the ISO 19119 standard for geographic information services architecture.

3.1 OWS Background

For the development of distributed applications in an open environments, there is a reference model called "Reference Model – Open Distributed Processing (RM ODP)", created by ISO and the International Telecommunication Union (ITU-T).

The RM-ODP is an architectural conceptual framework that integrates aspects related with the software system distribution, interoperability and portability in a way that the heterogeneity of the hardware, operative systems, nets, programming languages, data bases, and different business models are transparent to the user (Goodchild 2000).It is a model based in the object theory which specifies a system from five different perspectives or points of view: Company, information, computing, engineering and technology. All of them must be complementary, but never contradictory among them. The model allows to make proper questions with a sufficient abstraction and precision level in order to reason correctly about the inter operation systems.

Many companies are using these reference models in order to try and organize their applications and technology. However, given the complexity of the spatial information as far as its topological relation proper of its nature, efforts have been made to develop a distributed processing architecture, applicable especially to the spatial domains.

One of these efforts is placed in the "OGC topic twelve Abstract specifications" where an architecture based on the RM-ODP is specified. The spatial ambit is fixed making reference to the interoperability services proposed by the OGC. Within the ISO and OGC cooperation agreement this specification passed to be the standard for the ISO 19119 Geographic Information Service Architecture.

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1 Abu-Dhabi Global Environmental Data Initiative
2 Euro-Geographical and European Umbrella Organization for Geographic Information
3 Geographic Information Network in Europe
4 Permanent Committee on SDI for the Americas
5 INfrastructure for SPatial InfoRmation in Europe, a regional geo-spatial data initiative of the European Commission (EC)
6 Open Architecture and Spatial Data Infrastructure for Risk Management: http://www.eu-orchestra.org/
7 Wide Information Network: http://win-eu.org/
8 Open Advanced System for dISaster and emergency management: http://www.oasis-fp6.org/
9 Global Monitoring for Environment and Security: http://www.gmes.info

3.2   OWS key topics

To reach the interoperability of the geographic information, OGC developed an architecture oriented to services called OWS. Its functional principle is to provide and use services within a distributed computerized system whose platform is Internet. OWS architecture functional model is based on the creation of functional services in the geo-spatial ambit to publish them in different catalogues, making them available to the client to be found, tied, and used. Within OWS architecture there is not a clear definition of client-server, these roles are interchanged depending of the functions to be reached. The architecture of the servers can also operate on stored data in a local form or by retrieving stored data in remote machines. Some web services that OGC suggests to use in their OWS architecture are standardized services (standard factor) and others in discussion processes. OWS architecture presentation has a neutral focus for the use of the software: There is no condition to use any fixed-kind of software in the SDI implementation. This possibility places the owner and free software in the same conditions. Nevertheless, the use of free software is presented as an alternative widely considered in different Countries in the construction of SDIs among other alternatives because diminishes the high capital investment that characterized these projects.

4.   OPEN SOURCE SOFTWARE INTO SDI

4.1 Introduction

The software has become and strategy factor in the last decades for many economic sectors. The presence of open source software, and its penetration in a lot of the economy fields, has changed many the market strategies. The new approach is based, not in selling software, but creating a service market (McCauley 1996).

Few years ago, the open source software was something proper of concrete sectors for users with advance informatics knowledge, and with hardly user interfaces. In general, the free software was synonym of no cost. However this has evolved. Some free applications have been used as an alternative to the cost-software. There is an open source initiative (OSI) dedicated to promote the good use of open source software in the world community.

The expressions opens source (OS) refers to a group software licences that liberate the source program code, in order to give developers the opportunity for reading, redistributing and modifying the original source codes. This allows the possibility of reaching new functions reusing the software pieces that already exists. The OS breaks up with the idea of the closed-software model, or owner-software model, where there are only a few ones who know the application source code.

In the other hand, there is the property software (PS) developed by companies which has the unique access to the source code. They based their business strategy in the commercialization of licenses for executing the software. These products used to have two main problems. The first one is the high cost of the licenses that companies justified in the compensation of the engineering work. This situation is unjust because the license prices are very similar in the entire world (with independence of the income per capita of the country). In addition, because the companies have the only gateway to access the source code, they decide which will be the evolution of the products and the user has no chance to modify it.

The presence of the free open software movement (FOSS) in projects related with GIS is recent, but given the characteristics of the PS, it is influencing technically the SDI development in many nations. The United Nations, in its policies, recognizes and recommends the use of OS.

The OS in SDIs brings a lot of important advantages in their construction such as:

- To facilitate the technological construction process around – collaborating communities and government structures diminishing each individual organization investment.

- It will diminish notably the costly software licenses that eventually would be replaced by not so high priced software.

The importance and acceptance these initiatives have had along the word has generated the interest to evaluate the OS competitively. This is how APACHE foundation was born. In a more specific level, it is possible to find the equivalence into the GIS world in the Open Source Geospatial Foundation (OSGEO).

The OSGEO is officially registered in the state of Delaware U.S.A. It is a not-for-profit organization dedicated to the collaborative development of geospatial technologies and data. It was born with the closing up of Autodesk to the OS world. At this time, the organization studies and evaluates a group of several open source GIS tools to be used, specially on developing nations, in the academic, and in the public administrations.

It is important to outstand the fact that the open source software has its own business model. It has a price that is set by the service that in general is necessary to contract for configuring and putting the components to work. The concept of OS includes not only the right to use, but the right to copy, modify and distribute it according to a type of license.

4.2 Open Sources licenses

A software license is the mechanism by which the owner of the software authorizes a third part to use the program under certain conditions without selling it. This means that when the software is bought you are really buying the rights to use it according to the license that applies to the product.

As the PS level, the most know license is the one named "End User License Agreement" that gets the user the right to execute the application, and the source code in binary to avoid its modification or alteration. At the OS license field, the most habitual one is the General Public License (GPL). This type of license guaranties the user the right to execute, read modify and distribute the application, and obliges that the alterations and distributions realized on the original software be done guaranteeing the same rights.

The OS changes the software marketing strategy to the maxim interest factor at the licence level for the GIS integrators and consultants. The modifications at the distribution level are conditions that correspond with strategic, technological or philosophical objectives, proper of a sector or individual. This has generated the creation of several types of licences which can be summarized in the Table 1.

Table 1. OS licenses resume

Licence	Can be mixed with other non free software	The works added can be privatized	The alterations can be privatized	Does not have use or distribution restrictions	Has to distribute with the same licence
GPL					X
LPGL	(X)				(X)
MPL	(X)	X			(X)
BSD	X	X	X		
Public Domain	X	X	X	X	

4.3 Open source components for SDI Construction

It is evident the influence that the OS has had in the SDI creation. For this reason, this section presents a brief list of the OS products available (client and servers) now (the list is growing day by day, and some projects end and has no future), which can be used by any integrator or consultant in SDI construction. This list is not exhaustive and some gaps could be found. It is interesting to remark in this sense that only Sourceforge (http://sourceforge.net), maybe one of the most popular open software web sites, has more than 165.000 projects registered (with more than 1.760.000 registered users).

Main of the OS projects available for the implementation of GIS has been realized with the financing that a lot of countries had made in their NSDI construction (this has been done, for instance, in Canada or Spain). For this reason, a large percentage of the components that appear in the following table backup the protocols proposed in the OWS service architecture.

Table 2. OS Components on the Server's Side

DATA STORE	**PostGis:** Is a very popular product with important references along the world. It Is a product that gives PostgreSQL the capacity to store geodata and to realized geographic analysis. It is an open source project very active, in continuous evolution, with recent incorporations of dynamic segmentation route calculus.
WEB MAP SERVICES	**UMN MapServer:** Executable CGI that could be called from Web pages. To generate in a dynamic way images on the visual formats for publication on the spatial information's Web (gin, png). At the moment is possible integrate it in as applications server as Tomcat 5.0 bettering the security at the server's level which was questioned.
	GeoServer: Mapserver developed on J2EE applications, which allows the application deployment on any application's server according to J2EE specifications such as Tomcat, Jboos and Jeronimo at open source level, and web logic webspher at owner level.
	Degree: Java structure components that can be deployed on any server according to the J2EE specification. It supports a group of OGC specifications such as: WMS, WFST, WCS, CSW, WPS, SOS. Around this server other complementary projects have been developed as degree iGeoportal, degreeiGeo3D, DeeJUMP.
	MapGuide Open Source: Mapserver recently liberated by Autodesk as it is main contribution to the OSGEO's foundation. It has certain characteristics that can make it very valuable as the use of the FDO free library witch facilitates the Shapefile, ArcSde and Oracle data access.
METADATA TOOLS	**CatMDEdit:** Desktop toot developed in Java which allows the creation and edition of Metadata, according to ISO 19115, Dublin Core and CSDGM.
	GeoNetwork: J2EE application has an interface to work for web. There is other version to unload in local machine form it allows to edit, administrate and publish metadata according to the International Standards

The tables summarize the components making a difference between the server components (see Table 2), the client components (see Table 3 and Table 4), and of the GIS available libraries (see Table 5). It is interesting to remark that with some of the components described, it could be possible to build an SDI 100% OS (see Figure 1. SDI Software Architecture. The green color represents interfaces/communication protocols, and the blue color represents software applications).

Table 3. OS Components on the client's side (Light Clients)

LIGHT CLIENTS	**Ka map:** API of GIS web publication mainly programmed in javascript, with some components that should be installed in the server written in PHP to take advantage of the UMN Mapserver (MapScript) functions
	Chamaleon: API of GIS built in PHP that works on UMN Mapserver, and offers a group of widgets (user controls that offer concrete functions in getting the Map such as Zoom paneo, etc) that allows that a developer could publishes cartography applications with little effort. It uses AJAX to offer a dynamic user's interface.
	Carto WEB: API of GIS web application built in PHP on UMN Mapserver that exploits AJAX. It offers a framework with modular and scalable architecture which allows separating the logic and service through SOAP communication.
	Open Layers: API for Web GIS publication with JavaScript classes, without server dependence. It offers a simplified user interface. It could be connected to WMS Services and WFS.
	Map Bender: Web GIS client built with JavaScript. It offers a user configurable interface, independent from the Map Server. It can interact with WMS WMC and WFS-T services with this last one editing can bud on.
	Map Builder: Web GIS client built on two components: a JavaScript function library, and a server written in PHP or J2EE. It has a very good documentation, design patterns, and development methodology.

**Table 4. OS Components on the Client's Side (Heavy Clients)**

HEAVY CLIENTS	**GRASS:** GIS Desktop software that offers the visualization and analysis of the geographic information in raster and vector form with a low friendly interface. It is very popular at the academic ambit.
	Quantum GIS: GIS Desktop software that provide users with basic visualization and analysis necessities. It has a very simple and agreeable interface for the manipulation of the geographic information (inherits a lot of grass functions). It has been programmed with the user interface QT. It is quick and its plainness are outstanding.
	SAGA: Gis Desktop software with a clear separation between the user interface and its programming API. It outstand its orientation towards raster image analysis and the field of digital models.
	Map Windows: GIS Desktop software that offers the visualization, and analysis of the geographic information as an API with an active control X to realized specific applications. Is oriented to the development in platforms Net for Windows.
	Word Wind: GIS desktop software project for 3D visualization, with many similarities with Google Earth, but with a scientific orientation
	Open Jump : GIS Desktop software realized in java. Outstands for using the JTS libraries to realize some spatial operation analysis as well as the GML support and the WMS protocol since it peered.
	UDIG: GIS Desktop software realized in java on a platform for the development of RCP applications given by the eclipse project. It has as objective to meet most of OGC specifications.
	GAIA : GIS Desktop software developed in NET platform. It allows access to Microsoft virtual Earth, Google Earth, Yahoo Maps, OGC web services, GML, ESRI Shape files. It is part of a project called Carbon Tools and Microsoft.

Table 5. OS in GIS Libraries

GIS LIBRARIES	
	JTS Java library that provides support for 2D topological functions, replacing the specification Sample features Specification for SQL of Open Gis.
	GDAL: Group of command lines for the raster format translation developed in C++ and backed up in several operative systems.
	OGR: Group of command line uses for reading and writing access to vectorial file formats.
	PROJ4 Deals with the re-projections between different coordinate systems it comes up as a re-programming of antique uses of the UGS. It is implemented in C
	Geo Tools: Java library for the manipulation of spatial information. It is not a user final application; There are basic components to construct them. It offers access to the most important vectorial data formats and meets with several OCG specifications
	Batik: Java library that offers back up for the handling of data Scalable Vector Graphics SVG as format for vectorial cartography. It is very used in GIS projects.
	WKB4J: Library based in java objects for reading Well Known Binary information (WKB) from of a data origin, and to translate it to a geometry model. Its most common use is the passing of the information from Post GIS
	FDO: Library written in C++ that operates in Windows and Linux for accessing to vectorial and raster data.
	Mono GIS: API of GIS development for Windows or Linux. It includes a WMS server that its distributed with LPGL license.

With the combination of some of the described software's components it is possible to create open source based architecture (see Figure 1).

Figure 1: SDI Software Architecture. The green color represents interfaces/communication protocols, and the blue color represents software applications
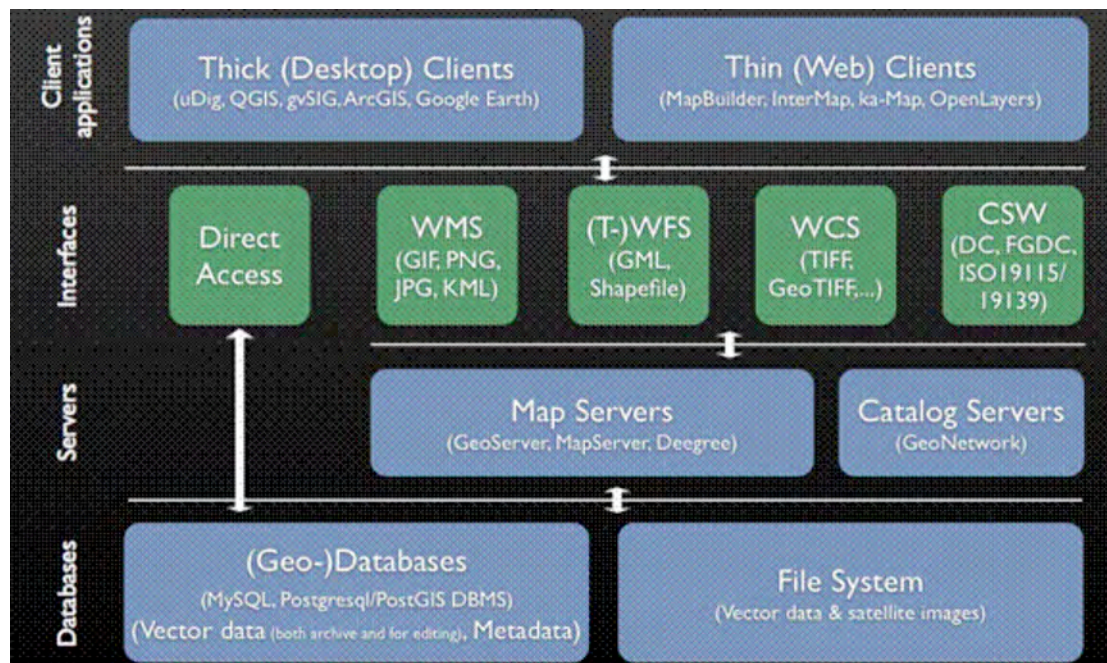

5.   BUILDING THE PROTOTYPE

5.1 Presentation of the Prototype

In order to convince Colombian organizations about the benefits and opportunities of developing SDIs with open source technology, a prototype has been built using this approximation. The main criterion to building this prototype is to improve the competitiveness of the administration by fomenting the production and the maintenance of the geographic data and allowing the possibility of a real

interchange between the different organizations in Colombia. This prototype will be also used for evaluating the variables that become involved in the implementation and use this experience in the subsequent development in entities owning a GIS and entities without a GIS platform. The prototype will be built assuming that all the SDI's follow the same technological paradigms; this implies that the exposed techniques in this work are expandable to other SDI projects at different hierarchy levels (SDI national, local or regional). For that reason the prototype is assumed as the beginning of the technological relations between the different produces and user of the geographic information in order for the government to have enough information at all levels for the creation of development policies.

Figure 2: Data source for the IGAC Web services compatible with OGC
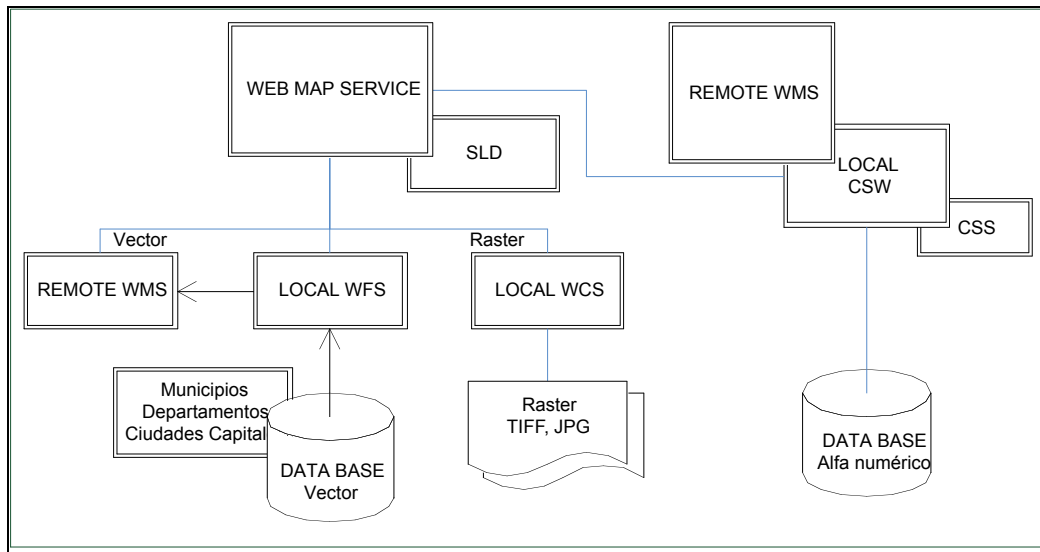
This prototype is conceived as the future forefront of the geospatial data of Colombia so it will provide the services web basics as catalogue, portrayal and data access services. That data is leased to prototype by their respective owners, who will keep in charge of their production and maintenance.

One of the main elements used for building the prototype has been the Deegree advanced technology. Deegree is a Java framework that offers the most usual building blocks for Spatial Data Infrastructure (SDI). Deegree Web Map Service (WMS) technology does not implement direct data access. All data that is used to create a IGAC map will be accessed via a Web Feature Server (WFS), Web Coverage Server (WCS) o other WMS. This means that if setting up a deegree WMS must be also to configure at least a LOCALWFS or LOCALWCS (see figure 2). WFS and WCS can be realized locally to mean in the same Virtual Machine, or remotely as a web service (see figure 2). Different WMS layers can be delivered by different WFS, WCS. The figure 2 shows the setup and configuration of the deegree Web Map Service, an implementation of OGC's Web Map Service Implementation Specification 1.1.1. The IGAC WMS is able to render vector data storage in an database PostgreSQL/Postgis as well as raster data from different formats (tiff, jpg).

The IGAC web services were realized as java modules controlled by one central servlet. This servlet has been integrated into the Apache-Tomcat 5.5 servlet engine, its status as an open source product. The configuration of the web services of IGAC to demand the editing of different XML files wich control the functionality of the server. The WMS follows ISO 19128 ("Geographic information - Web map server interface"). Besides the services were integrated display maps and catalog metadata

to give users greater versatility. Also is capable of supporting Style Layer Descriptor SLD 1.0.0.

5.2 Geo-Portal

In order to provide access to the OGC Web Services, a geo-portal has been developed. It also contains the information of the project (see figure 3). The portal is the gateway for two client applications with GIS functionality that access to the OGC services. The first one is called Map Displayer ("Visualizador de Mapas" in Spanish) and the second is called Metadata Catalogue ("Catalago de metadatos" in Spanish).

Figure 3: IGAC prototype geo-portal

5.3 Client Applications

The first client that can be accessed from the portal is called Map Displayer. It ha been implemented in Java and access to the Web Map Server and Web Feature Server.

The thematic layers of departments, municipalities and cities are the political administrative division of Colombia. These can be displayed on the client module thanks to the LayerListView. This module describes a list of the layers of a map but unlike the legend module can be changed during runtime (see figure 4). The layers can be shifted in their sequence and can be switched on or off. Besides, it is possible to define layers which can be queried by a GetFeatureInfo-request. The viewer allows maps add another OGC services, therefore it is expected to add information from Colombian entities producing geographic information. It also has a help line that provides the user to perform the basic functions of a GIS.

Each user is able to store the current state of the portal in a OGC Web Map Context document that can be loaded again later to restore the portal state. The WMS client is preconfigured to work with a locally installed Deegree Web Map Service, but there is no limitation for using other OGC WMS, for example like UMN Mapserver or ArcIMS that can be installed on remote machine.

Figure 4: Map Displayer: LayerListView

The display of maps allows detecting geographic information depending on the scale display. The Legend module is able to visualise the legend of the associated map. It calls the GetLegendGraphic-Fuction of the IGAC Web Map Services. There is also a module that provides an over view map at a set display resolution for the area of the entire context (see figure 5).

Figure 5: Map Displayer: Legend
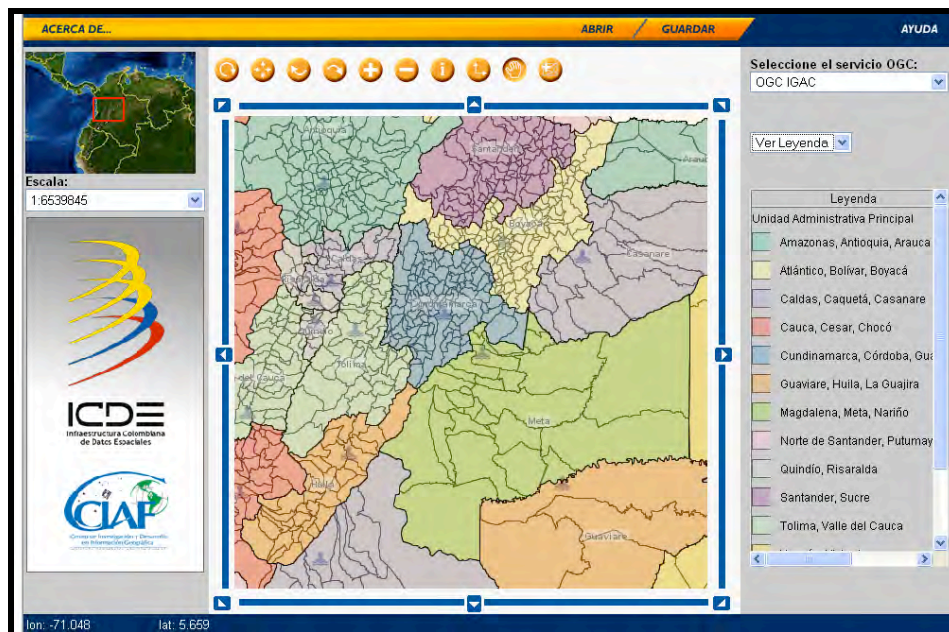
The second client that can be accessed from the portal is called Metadata Catalogue ("Catalago de metadatos" in Spanish). This client is based on the open source GeoNetwork (see figure 6).

The main goal of the Metadata Catalogue is to improve the accessibility to a wide variety of geodata. Its provides immediate search access to local and distributed geospatial catalogues; up-and downloading of data, documents; an interactive Web

map Viewer to combine Web map services from distributed servers around the Colombia; online editing of metadata and group and user management.

Figure 6: Metadata Catalogue

5.2 Architecture

The general model for a SDI has been presented in many papers and system developed. The main problem is how to implement the general model with the special characteristics of a specific country (Wernest M 2003). In order to obtain it, the Colombian geographical organization's information has been conceived as a series of topic cells (see Figure 7). Each cell represents one of the entities that will make part of the Colombia National SDI. In each cell there are specifications owner of each entity, but joined so the data can have a global use.

Figure 7: Technology SDI – Node basic
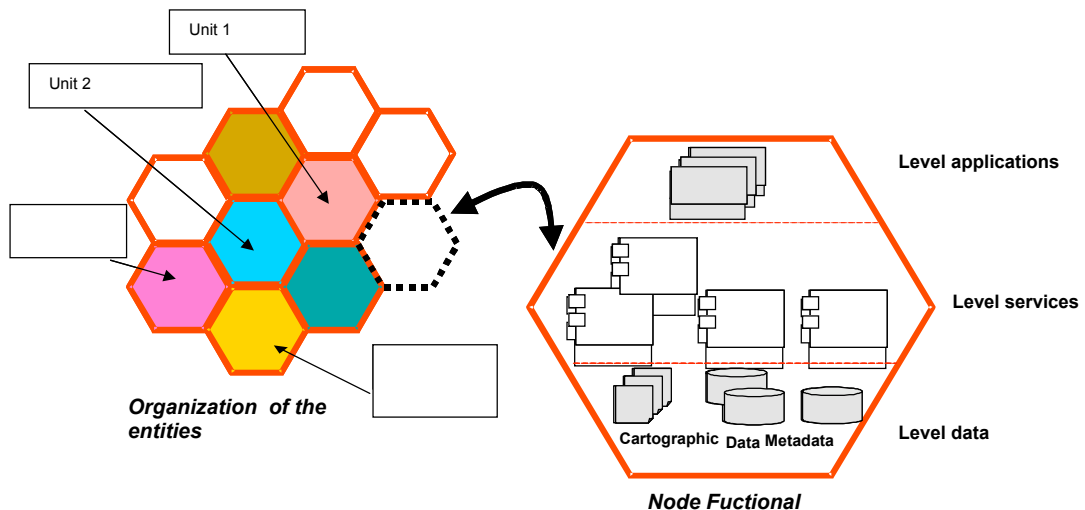
Each cell plays the role of node base which mission is to provide basic geographical services such as catalogue metadata and cartography's visualization. The services is accessing through a client GIS that supplies the basic tools to manipulate geographic information. The node base minimizes the geographic

information and tool duplicated. Is the responsibility of each entity that participates in national SDI to generate the added value on basic geoservices.

The architecture that is shows in the prototype must be understood as a basic spatial service node. In the cell model, each one can have GIS uni-functional applications which make sense within the internal mission functions of each entity, but are joined in such a way that on the same time there are GIS data of common use (Williamson IP 2003). The technological cell concepts symbolizes the changing of the geodata provided from different sources in order to make it available to the users and global applications following the open data policy that is currently used by the Colombian government.

Figure 8: Architecture of the prototype
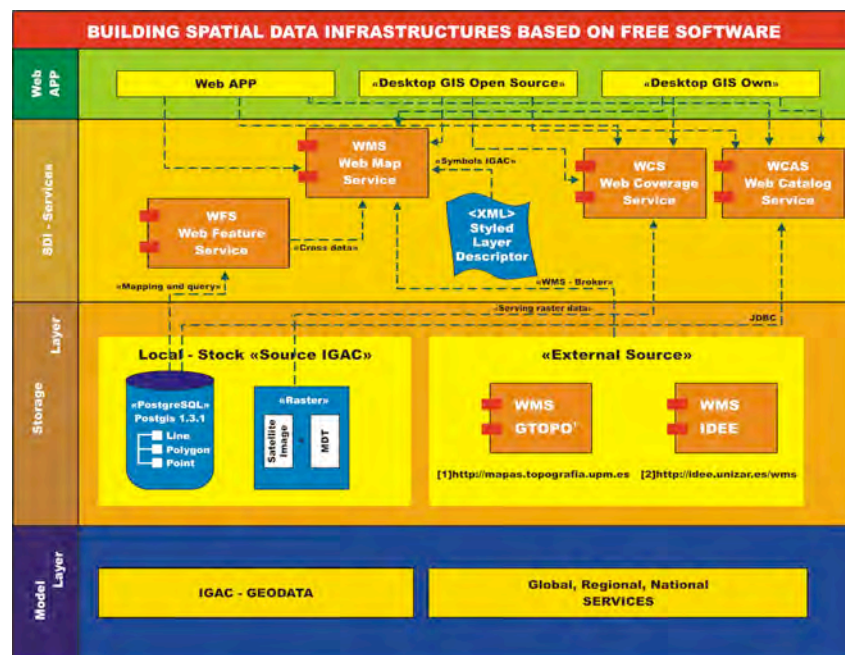
The prototype has been built over the information provided by two hypothetical Units of the Colombain National SDI. Following the previous analysis, the prototype is based on a service-oriented architecture and inspired by the OWS, will allow integrating without greater modifications GIS data and technologies of both Units (see figure 8).The prototype is also the interoperability test required by the stakeholders. As a consequence, a key goal of the building of the prototype is to evaluate as many interconnections as possible between technologies/philosophies that are at the present time in Colombia.

These range of technologies include different spatial databases philosophies, the closed one Oracle plus ArsSDE and the open source one PostgresSQL plus PostGIS, different basic service portrayal philosophies, the closed one ArcIms and the open source one Deegree 2, and so on. It has been necessary to add proper products to the prototype in order to prove the viability of the open source solutions, and because several Units has contracts with company for the maintenance of this kind of products.

To adopt the conceptualization of cells in the creation of the prototype architecture permits to understand that in a SDI the territorial data, gotten only once and its conservation is done in a more efficient way, also it means that there is not an inherent necessity of change in the habitual work schemes, in the entities that want

to share their geodata. The schemes can be kept and on them create the way to get the geodata.

The concept of cells and basic nodes come from the characteristics of distributed processing system that allows implemented web geoservices over remote data (as geodata rented). The access remote geodata's sample on the prototype is done at the implementation level, using two servers to develop it. The geographic information is stored in a server, while the other one provide hosting for the geoservices along with the supplementary components for their execution (Apache +Tomcat). This separation shows that independently of the geodata location, the geoservices can be access through TCP/IP protocol and use their functions. This separation also shows that the corporative GIS are not SDIs, but it could be a possible building block of them. Also the computer for development could be understood as the server that provides the web geoservices. The geodata and geoservices separation permits to understand the key topic for the SDI's building which is the geoservice integration not the sale of GIS software (Zarazaga Soria 2006).

6.   CONCLUSIONS

This paper has presented an overview of a pattern model in terms of OGC specifications, open source technology, responsibilities, roles and scopes for building the main node of the Colombian Spatial Data Infrastructure (CSDI). This main node is currently being defined and set up by the Agustin Codazzi Institute, which produces basic reference geo-data at the national level. Because the Colombia decentralized political organization, the CSDI has to be built over a distributed information infrastructure. The IGAC proposes the creation of several nodes over OGC services and with open source technology. In order to convince Colombian organizations about the benefits and opportunities of developing SDIs with open source technology, a prototype has been built using this approximation. It has been necessary to add proper products to the prototype in order to prove the viability of the open source solutions, and because several Units has contracts with company for the maintenance of this kind of products.

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