# THE CUBAN SPATIAL DATA INFRASTRUCTURE AS THE BACKBONE OF THE NATIONAL GEOGRAPHICAL PORTAL

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## ABSTRACT

Theme: Spatial Data Infrastructure, Geospatial Portals

The evolution of Geographical Information Systems towards the current Geospatial Portals in the world has been possible for the development of National Spatial Data Infrastructures (NSDI). The main focus of SDI is to share geographical information among user communities in the society. The factors involved in the implementation of NSDIs are multiple and derived from several perspectives.

This paper describes the elements taken into account in the implementation of the Cuban Spatial Data Infrastructure (IDERC) viewed from 5 perspectives: business, information, computation, engineering and technology, with conformance to ISO/IEC 10746 Reference Model of Open Distributed Processes (RM-ODP). As part of the IDERC modelling, some characteristics that distinguish it regarding other traditional NSDIs are also depicted.

Particular focus it is done on a new Catalog Service approach based saptial searching as an alternative useful to some countries with similar characteristics to Cuba, such as: low distribution of geospatial data (high concentration of providers) and/or low servers connectivity capacity of the providers. In this sense a comparison of a group of parameters between this and the traditional z3950 Clearinghouse approach is presented.

Additionally, the Cuban Geographical Portal, its components and services are also described. The launching of the first National Geographical Portal in Cuba was an important event of the Cuban Spatial Data Infrastructure in 2005.

Finally, the IDERC future work, its sustainability and the new goals to the next years are summarized.

## 1. INTRODUCTION

As part of the evolution of the Information Infrastructures, a particular kind of them has arisen, known as Spatial Data Infrastructure (SDI), distinguished by its complexity given by its own geospatial nature. SDIs are also a result of the evolution of Geographical Information Systems (GIS) from its foundation in the 60's decade where they were oriented to standalone projects, till the current society-based GIS thanks to the ubiquity of Internet and supported over SDIs.

"An SDI hosts geographic data and attributes, sufficient documentation (metadata), a means to discover, visualize, and evaluate the data (catalogues and Web mapping), and some method to provide access to the geographic data. Beyond this are additional services or software to support applications of the data" (Nebert, 2000).

In Cuba, the Hydrographical and Geodetic Service and the Ministry of Informatics and Communications have the purpose to coordinate the efforts to conform a National Council of Spatial Data (CNDE) to undertake the creation of the SDI of the Republic of Cuba (IDERC). The challenge of a National SDI in Cuba moves into several organizational, economic, technological and scientific problems. A recent Global survey of United Nations to determine the level of e-Government readiness demonstrates the gap between developed and developing countries regarding telecommunication infrastructure, Web connectivity and human capital. Cuba in this survey exposes a high capital human index (0.90) against low indexes of telecommunication infrastructure (0.051) and Web connectivity (0.166) (UNDESA & CRC, 2003).

Some countries attempt to clone the individual SDI "recipes" of other countries, with little success. Best practices around the world cannot always be applied equally in countries due to the differences (organizational, technological, financial, etc) between them. Specific conditions in Cuba and a comprehensive analysis of the requirements of the Catalog Service allowed the modeling and implementation of a new searching approach waiving Z39.50 protocol, based on spatial searching and reusing the Web Map Server and Web Feature Service Specifications from OGC.

An integral modeling of the Spatial Data Infrastructures in countries with low economic development, from five perspectives (entreprise, information, computation, engineering and technological) (Delgado, 2005) and the increase of digital cartography availability were important factors to implement a first stage of the Cuban Spatial Data Infrastructure (IDERC) and to launch the National Geospatial Portal.

## 2. THE PROJECT OF THE SPATIAL DATA INFRASTRUCTURE OF THE REPUBLIC OF CUBA (IDERC)

Since 1999, the Hydrographical and Geodetic Service and the Office of Informatization in Cuba have encouraged and undertaken a project aimed to create the Cuban Spatial Data Infrastructure. The first stage of this project, that could be called as a "Capacity Building Stage", embraces the period between 2001 and 2003, which is characterized for the following issues:

- Seminars, workshops and courses on SDI (with national and international professors an addresed to political and technical levels) were carried out.
- The first hierarchical and inter-institutional relationships were established.
- A group of OGC specifications were implemented (WMS, WFS, WCS).
- The first steps to establish a more appropriate legal framework to support the IDERC were undertaken.

The second stage of the IDERC Project begins in 2004 and continues up to date. It could be characterized as an "Implementation Stage", including the following aspects:

- Two agreements of the Ministries Coucil were approved into the framework of the National Strategy of the Information Society.
- An Integral Model of SDI to countries with low technological development was development.
- The National Geospatial Portal has been launched with the first map services of the IDERC.

### Model of IDERC based on the five perspectives provided by Reference Models of Open Distributed Processes (RM-ODP).

The perspectives of the model of IDERC, according to RM-ODP, are generalized from the PhD research of the author (Delgado, 2005). They can be appreciated as follows:

1. Enterprise perspective: Defines its purpose, scope, activities (use cases), actors and policies.
   Purpose: To share the geographical information in the society.
   Scope:
   - Users: Multi-levels (local, national, regional, global) and multi-sectors (government, industry, academia, citizen)
   - Content: Basicly (but not limited to) fundamental geographical data on multi-scales.

   Activities (Actors and activities):
   *Actors*:
   - Provider/Producer: This group includes providers, and producers of data, metadata, and services, even the info-communication and value added services providers.
   - Brokers: They are the bridge between users and providers of the SDI.
   - Controllers: They have the mission to evaluate indicators following the functioning of an SDI and its continuing improvement.
   - Users: The final user of the Geospatial Portal and the services of the SDI.

- Politicians: Those in charge to establish and provide policies associated to the SDI. All actors must apply the policies generated by this group.

*Activities by actor (in a generalized abstraction level)* are shown in table 1.

Table 1. General activities by actors in the IDERC.

| Actor | Activity |
|---|---|
| Provider/Producer | Produce, publish, provide data and metadata and the services associated.<br>Mantain metadata<br>Apply policies delivered by politicians |
| Brokers | Harvest metadata<br>Create metadata consult<br>Process geoconsult from users<br>Apply policies |
| Politicians | Establish and provide policies |
| Users | Request for metadata and map services<br>Exploit map services according to policies<br>Contribute to the quality of services (feed back) |
| Controllers | Apply policies regarding control and quality assurance |

2. Information Perspective: It depicts the semantic of geospatial information and information processing.
   The information components in the IDERC are: core geospatial data, thematic geospatial data, vector layers, raster layers, geographic feature, attribute, metadata, metadata catalogue, service and service registry.
3. Computational Perspective: This perspective describes the services involved in an SDI, following the taxonomy of ISO 19119, as follows in table 2.

Table 2. Taxonomy of services in an SDI considering ISO 19119 services categories.

| Type of Service | Main Services in an SDI |
|---|---|
| Geographic human interaction services | GeoPortal portrayal services<br>Geo-consults.<br>Maps visualizing: Generic Viewing, Client Applications.<br>Metadata view |
| Geographic model/Information management services | Map Servers<br>Thematic Information Services<br>Metadata Catalogue Services |
| Geographic Workflow/Task management services | Inherited from info-communication services |
| Geographic processing service | Geospatial information transforming services<br>Integration services: Maps cascade, etc.<br>Generalizing services |
| Geographic communication services | Encoding –XML |
| Geographic system management services | GeoPortal management services |

**Thematic information services are offered by other information infrastructure, generally associated to vertical sectors such as Health, Government, Statistics, etc.*

4. Engineering Perspective: It focuses on the distribution of services, particularly in the ”spatial” searching of metadata. The figure 1 depicts this perspective.

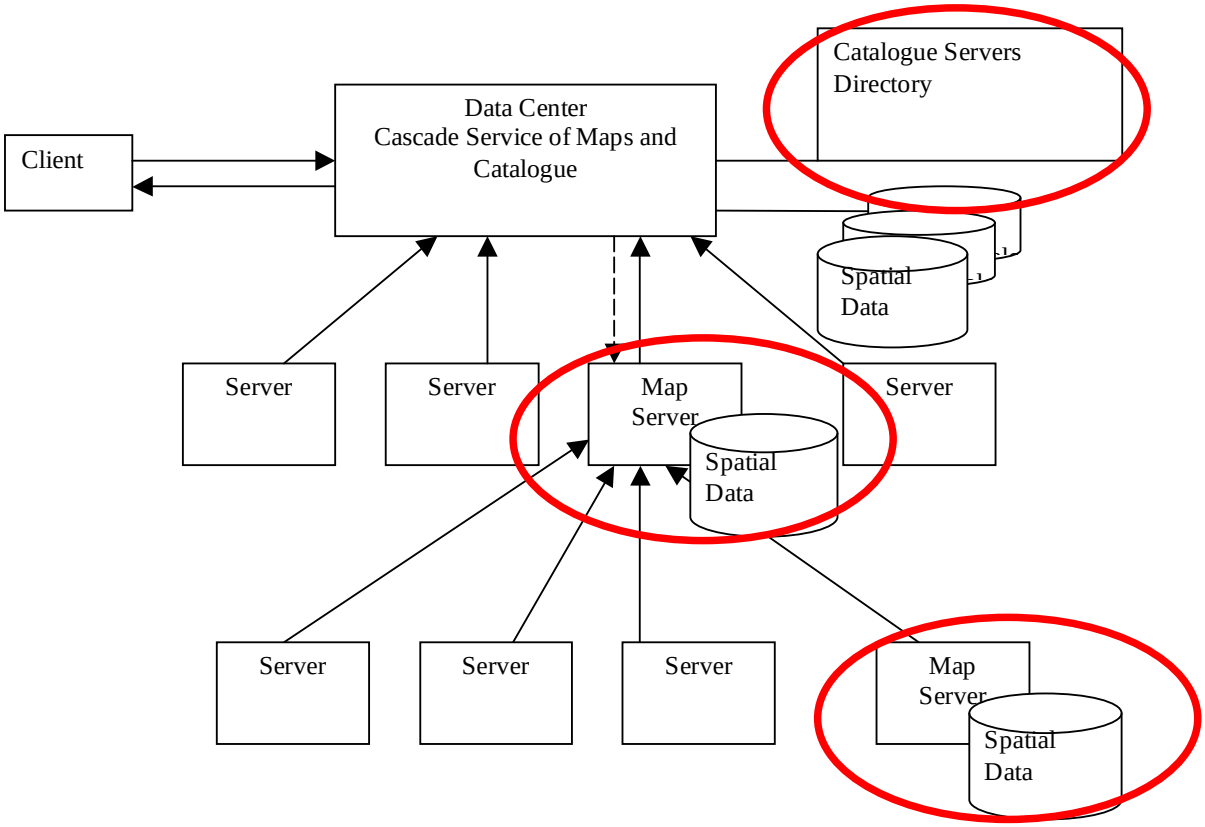


*Figure 1. Engineering Perspective of IDERC*

In the figure 1, it is appreciable a distinction regarding traditional implementation of SDI Catalag Services based on Z39.50 metadata searching approaches. The model waives Z3950 and instead it extends the use of Web Map Server and Web Feature Service Specifications of OGC to build the Catalog Service (Delgado, 2005). As a result an easier and spatial metadata searching catalog is obtained.

5. Technological Perspective: It is related to the subjacent infrastructure in the distributed system. The technology philosophies are mentioned as follows:
    - Interoperability.
    - Web Services.
    - Communication by TCP/IP (Internet).
    - XML as the information transport standard.

## National Geospatial Portal built over the IDERC

The National Geospatial Portal (GeoPortal) has the purpose to integrate in one site of Internet (http://www.iderc.co.cu) all services to access the geographical information available in IDERC according to the policies established.
The informative contents in the GeoPortal embraces two domains: the first one is a general information about IDERC and the second one has a scope to the geospatial services provided:

- Metadata Publishing.
- Metadata Searching.
- Visualization of metadata by means of XSLT.
- Generic visualization of maps (WMS, WFS).
- Geographic Information Services – Interactive maps.

The policies to access data distinguish anonymous and privileged users by means a login.

So far the Geospatial Portal includes:

*Map Server and Metadata of:*

- Special Map of Toponymy of Cuba, scale 1: 250 000.
- Topographic Map of Cuba, scale 1: 100 000.
- Planimetric Map of Havana City, scale 1: 2 000.
- Planimetric Map of urban zones of Cuba, scale 1: 5 000.

*Map Services:*

- Generic Viewer of Maps.
- Statistics Demographic Maps (Statistics Yearbook, 2003)
- Geographic Dictionary.

*Other services.*

- Geospatial Catalogue Service.
- Metadata publishing.

*Information section.*

The following figure 2 shows the homepage of the Geospatial Portal.

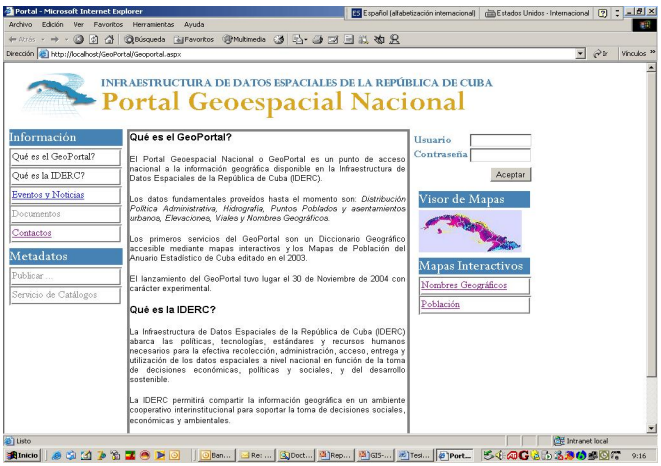


*Figure 2. View of the Geospatial Portal.*

## 3. CONCLUSION

The issues of Cuban SDI described in this paper illustrate the importance of modelling specific characteristics in each country in order to adapt the best model to the actual national situation.

To reach a comprehensive understanding of a SDI, it is necessary to describe it using a multi-perspective approach. The RM-ODP provided by ISO/IEC 10746 is a good way to undertake this task.

To waive the traditional approach of Catalog Services based on Z39.50 could be suitable not only to simplify this kind of service, but also to take advantage of the spatial search engine included in Map Servers, modelling metadata as features of a special layer in a map.

The launching of the National Geoespatial Portal is an important step in the evolution of the Cuban SDI; however future work will be necessary to tackle the important challenges of the society regarding geospatial services and to reach an effective infrastructure to share the geographic data with the participation of all the stakeholders identified.

## 4. LITERATURE REFERENCES

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