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Regional Spatial Data Infrastructures – What Makes them Possible?

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INTRODUCTION

The Global Spatial Data Infrastructure Association's *Spatial Data Infrastructure (SDI) Cookbook* (www.gsdi.org) defines SDI as "the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data."

SDI advocates promote SDI as public infrastructure, like roads and telephone systems. Like other public infrastructure, SDI provides a reliable, shared, supporting environment that makes individuals more effective in the world, businesses more profitable, and governments more efficient.

FROM THE BOTTOM UP, GEOGRAPHICALLY

Ultimately, data sharing networks depend on people and the relationships between them, so policies and institutional arrangements (including technology choices) ought to be easiest to arrange within a single a city. Even within a city, of course, multiple public and private entities must be involved in establishing, or at least accepting, the policies and instutional arrangements. But the relative ease of arranging face-to-face meetings for these purposes should make it easier for advocates of local data sharing to cooperatively apply their leadership skills and authority. Logically, it would appear that larger, regional SDIs ought to be much more difficult to establish, because distance discourages face-to-face meetings, and because many more people must be brought into agreement.

In the real world, however, regional SDIs are appearing at a rapid rate. Sometimes "region" means a world region, or group of nations. Sometimes "region" means a group of cities, counties, states, or provinces. Sometimes "region" means a group of institutions working within a particular domain, such as oceanography (e.g. http://www.openioos.org), and also within a geographic region. There are examples of each of these types of regional SDIs, and we have every reason to expect more to form, at an accelerating rate.

We also have every reason to expect that all of these will merge into a Global Spatial Data Infrastructure (GSDI).

FROM THE BOTTOM UP, TECHNICALLY

To understand or advocate SDI development, it helps to think of SDI as an entirely social phenomenon. To a technically minded person, an SDI appears as a data sharing network with many nodes, each comprised of computing devices that can produce, transmit, receive and/or process spatial data. The technical interoperability that is a prerequisite for Web-based, real-time access to multiple data and processing resources may appear to the technical person or the SDI user as merely a set of software features. But interoperability is in fact obtained through social processes.

Across the information technology (IT) industry, in the last 15 years consensus standards have made steady progress in dethroning proprietary standards. Previously, in any subdomain of information technology, a single dominant vendor usually set the standard. No longer. The Internet and the Web are only the most prominent of the examples that have shown technology users and providers the commercial advantages of a more democratic and global approach to standard setting. Now, agreements on software interfaces, data encodings and best practices are increasingly the result of formal social processes, usually global, involving technical committees that include both users and providers. In the geospatial domain, the OGC and ISO TC/211 are the most visible facilitators of these formal social processes, but their work builds on the work of standards organizations in the broader IT domain. Their work also involves coordination – often face to face -- with standards organizations in neighboring domains such as transportation, emergency response, 3D animation, databases, computer-aided design (CAD), and location based services.

SDI depends on a sequence of social processes that begins with the social processes that produce technical interoperability. After everyone’s computer systems “work together” to share geospatial data, the remaining policies and institutional arrangements are much easier to implement. As we can see from the rollout of regional SDIs, the mutual benefits are, in a growing number of cases, sufficient to overcome institutional obstacles to implementing new data sharing policies and institutional arrangements.

INSTITUTIONAL OBSTACLES AND OBSTRUCTORS

In a sense, all SDIs are regional SDIs. Only under autocratic political or corporate regimes can there be one over-arching authority that makes all decisions regarding such things as data content schemas, metadata standards, access policies, pricing policies, and access rights management. It is true that in some cities there is a “GIS dictator” who rules a “GIS fiefdom.” But increasingly, within a single city, nation or corporate enterprise, SDI development depends on the cooperation of peer organizations, as it must in regions.

Today, Web-based publishing of and access to data and processing services make it possible to do business in much more effective ways, but people and their institutions cannot change overnight. Individuals with authority over data sharing may believe that free and open data sharing is a major burden of little personal importance, or they may worry about legal liabilities, or they may feel obliged to capitalize on their data by charging significant access fees.

Certainly, managing spatial data is more complex than managing other kinds of data. Spatial data is often costly to produce, it often contains proprietary information, and it often is derived from different layers with different provenance and restrictions. Liability is sometimes a concern. Data layers that contain the same basic type of information may have been created with slightly or wildly different schemas. A dataset valuable to many different groups may be updated daily. Though technical standards have made it easier to “mix” different types of data – vector, raster, CAD, and location – users of the data often need to understand the essential differences between these data types. These and other complexities become part of the rationale for those data managers who would resist putting their data online for others to use. But data managers who resist SDI progress are swimming against the tide. The rapid advance of computing and geospatial technology are making old ways of doing business obsolete.

EXAMPLES OF REGIONAL SDIS

-- North-Rhine-Westphalia (GDI NRW)

In 1999, the German State North-Rhine Westphalia established its spatial data infrastructure, GDI.NRW, as a joint initiative of state agencies, municipalities, private companies and scientific institutes. In the beginning, several software projects were partly supported by public funding to develop the basic components of an interoperable solution for the GDI.NRW, following available OGC standards and the agreed profiles for NRW.

Before long, about 140 participating institutions were involved, and the benefits of a SDI were demonstrated in several test-beds and joint projects involving many partners. For example, in the 2004 “SDI NRW Joint Project”, GDI.NRW undertook 25 sub-projects in which participants developed more than one hundred OGC-interoperable geospatial services and 20 SDI-based applications. These activities produced an operational SDI kernel with more than 120 different services, and the results were presented at the Intergeo fair 2004 in Stuttgart.

As expected, this SDI development activity created new business opportunities, particularly in the areas of data development and management and Web-based software and website development. The German North Rhine Westphalia Sig3D organization, for example, developed CityGML, an emerging and globally important OGC standard for sharing urban models and integrating design drawings with spatial data. Their expertise is in demand, fulfilling the economic development vision of the early backers of GDI.NRW.

Virtual 3D city model of Ettenheim in Germany, automatically derived from an IFC dataset and manually enriched with respect to the employed CityGML feature types. http://www.citygml.org/

In 2003, Germany's federal and regional governments (Länder), backed by national associations of local authorities, adopted a joint strategy called Deutschland-Online to expand their cooperation in E-Government. One area of cooperation is "geoinformation, spatial data and spatial data infrastructure (SDI)". Based on the success of GDI.NRW, the Surveying and Mapping Agency of North- Rhine Westphalia was chosen to lead this unit.

Borders provide opportunities for further SDI coordination. Since 2001, cooperation between The Netherlands and NRW relating to spatial information has intensified, after several successful cross-border workshops. A regional SDI (RSDI) workshop held at the Joint Research Centre (JRC) at the beginning of 2003 made clear the need for cross-border SDI cooperation. Belgium has also become involved. The main application areas are disaster management, spatial planning, environment, recreation and transportation.

"Change on Borders" is a Regional Framework Operation (RFO) approved within the EU-program INTERREG IIIC. The CROSS-SIS-project (http://www.cross-sis.com/) is partly financed by the European Union within the Change on Borders program with the aim to enhance the use of spatial data for spatial decision making in cross-border settings, promoting the modernization of the regional administrations, the use of INSPIRE and the development of the information society (www.cross-sis.com). The ambitions of the project are closely related to the directives of INSPIRE (http://inspire.jrc.it/), so a decentralized approach is favored. The project uses a service-oriented architecture based on components that implement OGC standards.

IDEC: Geoportal of the Catalonia SDI

Early in 2002, the government of the autonomous region of Catalonia (Spain) began the IDEC project (SDI of Catalonia). The first year was devoted to general planning and preparation and to creation of the appropriate collaborative framework. The following year the institutional compromises and agreements were made regarding general understanding about the concepts, architecture and technologies proposed by the initiative. Implementation began in 2003.

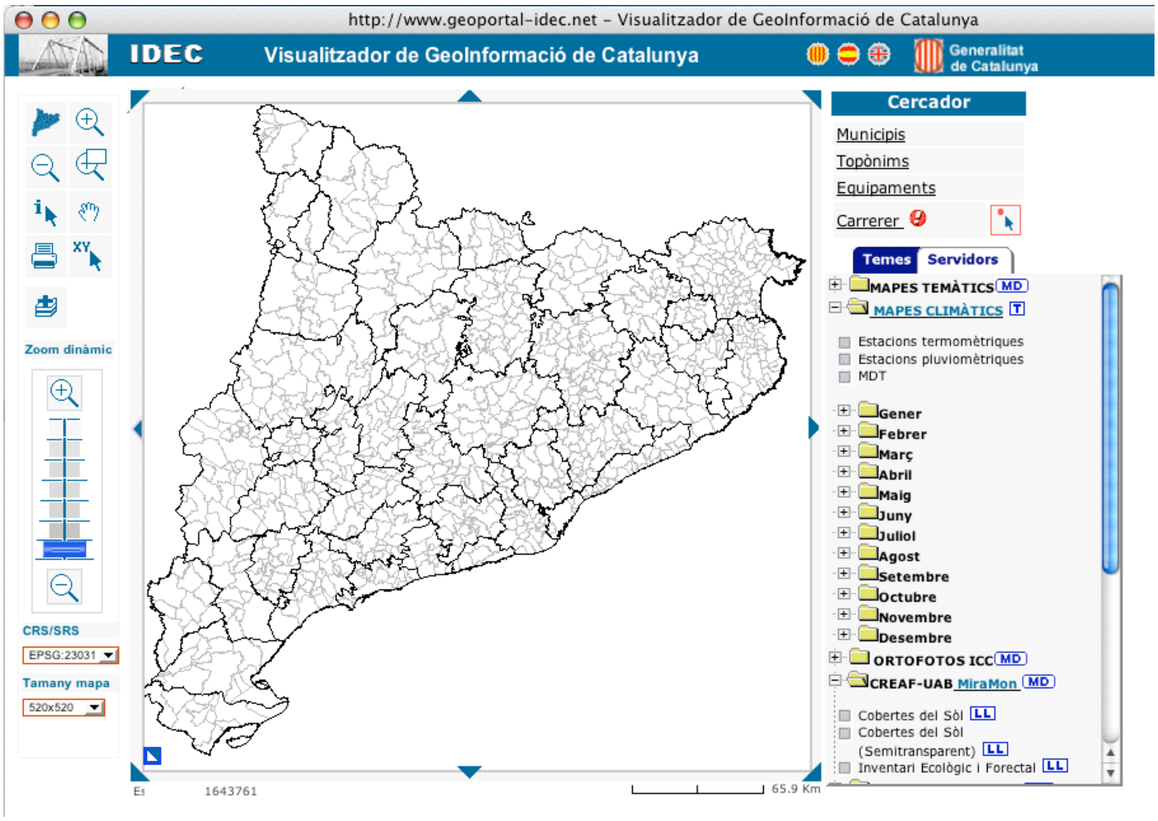
The regional SDI offers in its Geoportal several services, the most important of which is the multilingual Catalog Server, with more than 18,000 records of metadata available (53,000 in both Spanish and English), describing data available from over 80 providers.   metadata for services (about 40) are also available. The Viewer, a client that implements the OpenGIS® Web Map Server (WMS) Specification, allows the user to access more than a dozen WMS servers from different providers who together provide about 200 layers of geodata. Services that implement the OpenGIS Web Feature Service (WFS) Specification (for Web-based query and delivery of vector-based data) and the OpenGIS Web Coverage Service (WCS) Specification (for Web-based query and delivery of raster-based data) are also active.

This services framework is offered to other institutions and organizations as a platform to which others can add value, sharing and reusing the services for specific applications.

The IDEC strategy has been to promote SDI based Catalonia themes such as environment, coastal information, transportation, etc. This thematic approach, based on the IDEC platform, has had a clear impact on the models upon which other projects have been planned. Some important initiatives have changed their initial conceptualization, from a centralized model to an open and distributed architecture, from a proprietary system to a standardized one based on interoperable technologies.

One example is the EUROSION Project, a European initiative funded by the EC to promote better management of the coastal zones. Others include UNIVERS, a regional initiative in the framework of an INTERREG European Project to connect WMS of the university Departments in Catalonia to share land information and other geospatial information; ; and LOCAL, a recently launched project that aims to incorporate the municipalities in the Regional SDI. All are clear samples of a new era in managing GI technologies. The open SDI paradigm demonstrates the importance of interoperability concepts and technologies.

A regional approach helped the IDEC developers to set up and more easily promote projects based on SDI concepts and technologies, because of its intermediate position between the large scale of the State and the smaller scale of local government.



Catalan Map displayed on the IDEC Map Server. The viewer offers free downloads in GML, downloads of orthos, access to metadata catalog, thematic legends, control of transparency, gazetteer type search, and more than 200 layers of data.

OTHER REGIONAL SDIS:

NATO C3, the US Federal Enterprise Architecture, and the Group on Earth Observations (GEO) can all be seen as employing regional SDIs. The UK Ordnance Survey is using GML format to distribute its MasterMap product. The Australian SDI consists of a wide variety of OGC standards based enterprise implementations across the nation. Open Location Services (mobile wireless standards) are being built into consumer offerings from major location services vendors. And perhaps more than any other country, Canada has expanded the practical reach of national SDI development based on the Canada Geospatial Data Infrastructure (CGDI) into a wide variety of agencies at all levels of government.

SIDEBAR:

Other SDIs to look at include:

http://mapsherpa.com/tsunami/ Tsunami Information Portal Tsunami Information Portal, developed by DM Solutions (Canada) in concert with the Asian Institute of Technology, Chulalongkorn University, and Laboratory of Applied Geomatics.
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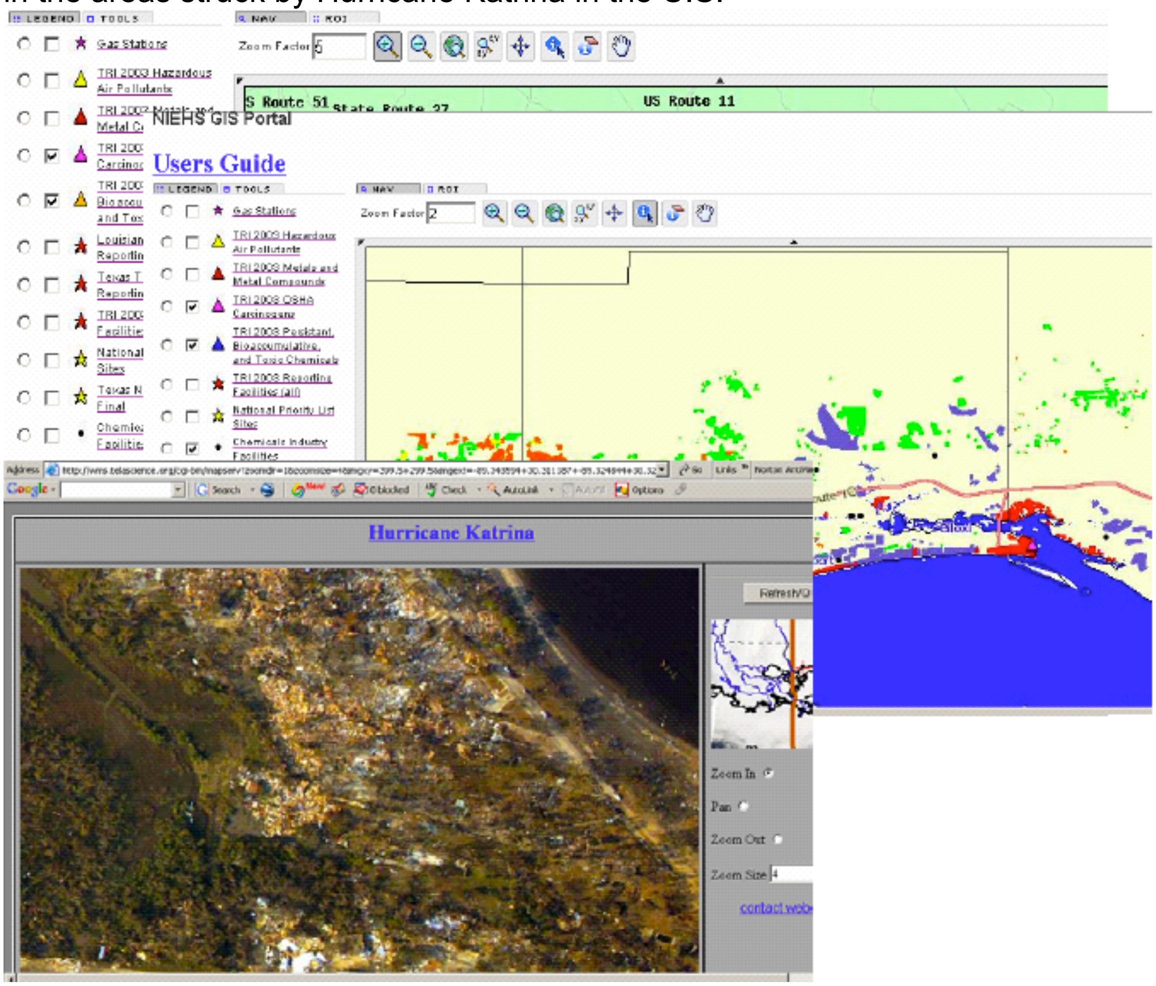
http://niehs.telascience.org/ Katrina Map Server Interface, developed with the National Institute of Environmental Health Sciences to support disaster recovery in the areas struck by Hurricane Katrina in the U.S.



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http://gis.ncdc.noaa.gov/aimstools/gis.jsp National Climate Data Center Portal (NCDC) is the world's largest active archive of weather data. The NCDC portal uses WMS and WFS interfaces to provide access to numerous climatological and meteorological resources.
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http://www.openioos.org The Integrated Ocean Observation System (IOOS) supports coastal oceans applications originating. It includes bathymetric data and many layers of science data. Semantic interoperability has been a key factor in the development of the system. A related effort, "Geo-interface for Atmosphere, Land, Earth, and Ocean netCDF" (GALEON) activity is focused on open access to atmospheric and oceanographic modeling and simulation outputs.
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The SDI of Catalonia (IDEC): Geo interoperability at a regional level, Jordi Guimet – Project leader. GIM, June 2005.

INSPIRE Technical Architecture
– http://inspire.jrc.it/reports/position_papers/inspire_ast_pp_v4_3_en.pdf

Australian Spatial Interoperability Demonstration Project Reference Model
– http://www.sidp.com.au/

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