eEnviPer White Paper #3

Integrating Geographic Information Systems and Workflows

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1 Executive Summary

"Interoperability seems to be about the integration of information.
What it's really about is the coordination of organizational behaviour."

David Schell, Founder and Chairman of the Open Geospatial Consortium

eEnviPer is an EU-funded project whose principal aim is to provide an integrated web-based platform for the application, administration and consultation of environmental permits, making the environmental permitting process more transparent, more accessible and more efficient. The platform will be available in early 2014 after intensive field tests in five different European countries, namely Croatia, Greece, Italy, Serbia and Turkey.

The eEnviPer solution provides a response to public authorities' need to combine the various databases and workflows required for the creation of a suitable e-government solution for environmental permits. eEnviPer uses a layered service-oriented and cloud-based architecture to take advantage of existing data sources and complementary environment-related permit systems. The eEnviPer architecture approach is built on the concept of smart integration of existing building blocks (Knowledge Management, Geographic Information System, Workflow Management and Participation System) based on the principle of reusing services already available in the portfolio of e-government solutions.

Geospatial information (the information contained in geographic information systems), in particular, plays a crucial role in the evaluation and decision-making processes for environmental permits: the engineers in charge of the evaluation of environmental impacts need to consult spatial data of various different types, which are processed, hosted and managed by different centres of expertise. Therefore, the ability to easily access geospatial information from different data sources is a key feature of eEnviPer.

This paper focuses on the how the eEnviPer environmental workflow is integrated into a Spatial Data Infrastructure (SDI) and on its adherence to the INSPIRE framework, both of which facilitate access to geographical information.

2 Spatial Data Infrastructure

Geospatial information has become an integral part of the information environment for people working in local and subnational (county, province, district, etc.) governments worldwide. Most government information has a geospatial component, and significant resources go into gathering and coordinating the management of geospatial information at all levels of government. Policies vary from country to country and from jurisdiction to jurisdiction, but usually governments choose to be primary providers of some types of authoritative geospatial information while coordinating and managing other types of geospatial data through partnerships with external institutions or companies. In this context, expensive duplication of effort is the rule rather than the exception, as offices, agencies, citizens and private sector stakeholders seek to obtain the data they all need to accomplish their objectives.

Geospatial information technologies, moreover, evolve constantly and will continue to do so. For example, a recent relevant technological evolution in the field of geospatial information management has been the changeover from a traditional web-based Geographic Information System (WebGIS) to a Spatial Data Infrastructure (SDI) (Figure 1). Forward-looking government policy makers know that they must adapt policies and institutional arrangements to accommodate and take advantage of these technological changes.

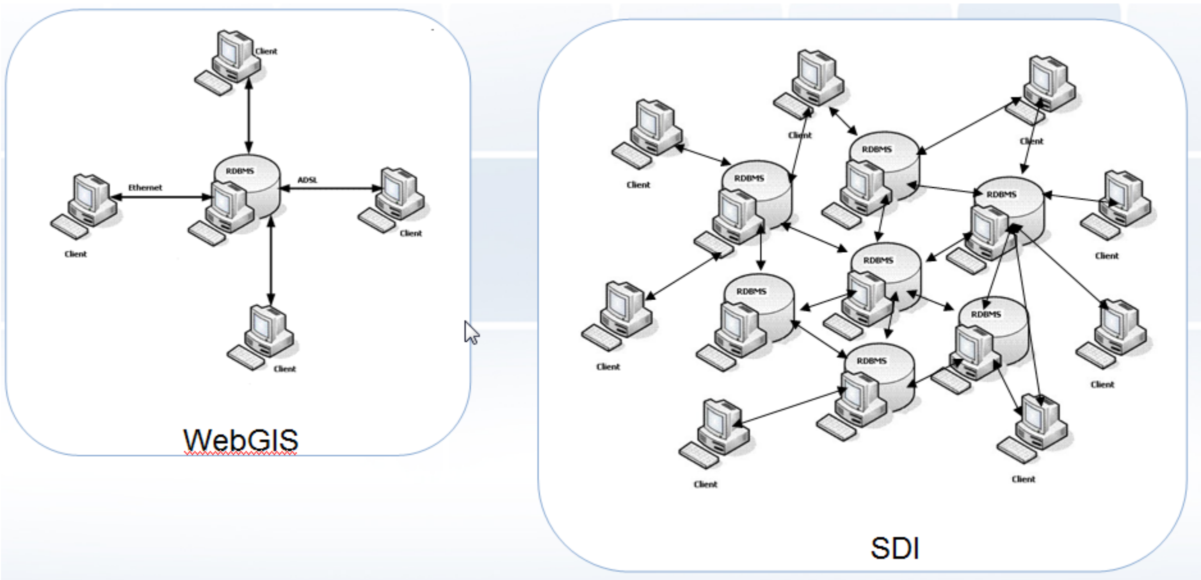

Figure 1. Transition from WebGIS to SDI

WebGIS is a web interface including a geographic viewer with capabilities to query, and sometimes edit, the underlying geospatial data, mainly stored in disks or databases hosted in a single local network. On the other hand SDI is the “collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data"[1] (Figure 2).

SDI = Policies + People + Data + Technology + Standards

Figure 2. Definition of SDI

SDI makes it possible to combine data even though it may be hosted on different servers across the internet Figure 3).The added value of SDI is the increase in intrinsic value of spatial data through its sharing: combining diverse data generates new information.

Figure 3. SDI structure
Source: http://www.opengeospatial.org/pub/www/files/SDI_figure.jpg

The SDI concept is based on the following pillars:

- ✓ **Reuse**: create data once and use it many times for many applications.
- ✓ **Cooperative governance**: integrate distributed data providers.
- ✓ **Sharing:** share costs for the creation and maintenance of data.

[1] The SDI Cookbook (http://www.gsdi.org/gsdicookbookindex).

The key difference between WebGIS and SDI is that machines and data interact without further human intervention once an SDI is set up. This process is only possible through standardised data formats and interfaces. Standards from the Open Geospatial Consortium (OGC) and complementary standards from the International Organization for Standardization (ISO) Technical Committee 211 (Geographic information) are essential elements in SDIs around the world.

The OGC's software interface and encoding standards, now widely implemented by software companies, make many things possible: data and services from countless sources can be accessed by Web clients; legacy (previous or old) systems "wrapped" in open interfaces can be profitably kept in service longer; and new systems and add-ons can be purchased with less risk of obsolescence. A desktop GIS can still serve its original purpose, but it can also be put online, becoming a web-accessible source of managed data that web services users can access remotely. Such resources can be registered in online metadata catalogues so they can be easily discovered and assessed. In all of these cases, there is much less of a need to individually customise the integration of systems, because open standards enable any system to "plug and play."

At the same time, cloud computing[2] is a trend resulting from a convergence of technologies such as broadband communications, virtualisation and web services, and is perfectly matched with the principle described above. It supports Service-Oriented Architectures (SOA)[3] based on OGC web service standards, enabling government geospatial IT departments to downsize by moving data - and perhaps also software platforms, tools and software - to remote data centres.

[2] Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (NIST, 2012).

[3] Service Oriented Architecture provides methods for systems development and integration where systems package function as interoperable services (GeoNetwork User Manual, 2010).

3 INSPIRE

In terms of policy frameworks for geospatial information, INSPIRE is "an EU initiative to establish an infrastructure for spatial information that will help to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development". The INSPIRE Directive[4] lays down a general framework for an SDI to support EU environmental policies, and policies or activities which may have an impact on the environment (Figure 4).

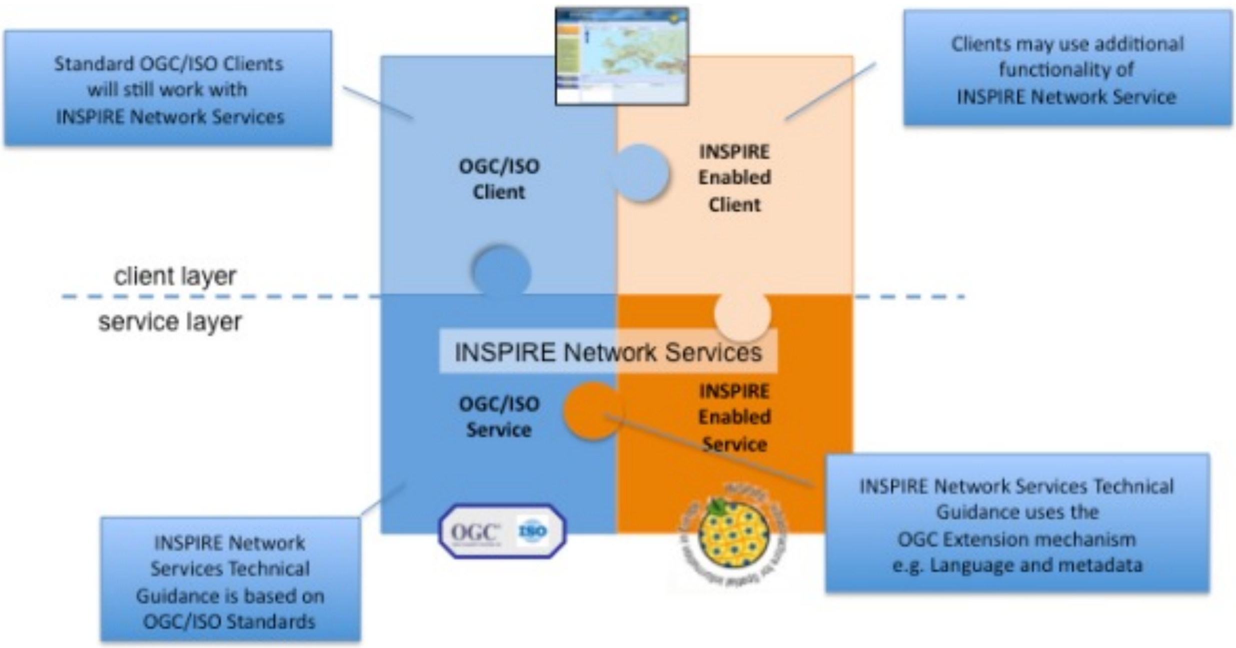

Figure 4. INSPIRE Network Services
Source: http://inspire.jrc.ec.europa.eu/.../TechnicalGuidance_ViewServices_v3.11.pdf

The Directive promotes the concept of interoperability among institutional SDIs, in order to make each of them a node in a hierarchical global spatial data infrastructure. To ensure that the spatial data infrastructures are compatible and usable in the EU's transboundary context, the Directive requires that common implementing rules are adopted in a number of specific areas:

- ✓ Metadata.
- ✓ Data Specifications.

[4] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007L0002:EN:NOT).

- ✓ Network Services.
- ✓ Data and Service Sharing.
- ✓ Monitoring and Reporting.

From these implementing rules, a set of best practices are applicable in the design phase of an interoperable GIS:

Step 1: Data must be searchable, and the design of archives must allow the management of metadata according to the agreed standards.

Step 2: Data must be usable, and the design of the process must allow the production of data according to the standards.

Step 3: Data must be accessible, and the design of web services must follow the standards.

The eEnviPer framework for managing geospatial information has been designed in compliance with these best practices. As described in the next section, once fully integrated into a public administration’s operational flows, the eEnviPer system has the capability to become a valuable source of environmental geospatial information.

4 eEnviPer and geospatial information

eEnviPer is designed to be part of the Global Spatial Data Infrastructure. eEnviPer integrates with GIS layers or existing systems that support environment-related permit procedures and provide digital services for permitting authorities at different levels, enterprises, consulting services and civil society.

The eEnviPer project partners responsible for the five pilots have prioritized the need to access geospatial data from various sources. As a result, eEnviPer's architecture has been designed to be compatible with SDI and INSPIRE and the eEnviPer framework has been designed to support the OGC standards (WMS, WFS, WCS, KML) which can be used to pull data from or to push data to other applications.

Furthermore, thanks to eEnviPer's SOA, the eEnviPer services layer is available for use by external systems which want to use the data provided by eEnviPer REST-ful services[5]. It returns data using the JSON or XML format, and provides an application programming interface (API) that can be easily configured and made available for almost any part of the data storage layer.

As an example, the eEnviPer's GIS component might access a data source containing all Natura 2000 areas in Europe. A simple query then establishes whether a new development is located in proximity to a nature protection area. Similar information about current land use plans or the location of other industries can be accessed or imported too. At the same time, information included in eEnviPer about the location and characteristics of environmental permits can be accessed through external systems.

The standardisation process is still ongoing: each year new standards, from the OGC and other standards development organizations, extend the possibilities of web-based SDIs. This evolving standardisation is incorporated in the eEnviPer approach: the ongoing standardisation of the environmental permit workflow and of the permit-related data, towards more efficient and more sustainable e-government processes.

[5] REST stands for Representational State Transfer, a style of software architecture for distributed systems such as the World Wide Web.

5 Acronyms

API	Application Programming Interface
GIS	Geographic Information System
GSDI	Global Spatial Data Infrastructure
INSPIRE	Infrastructure for Spatial Information in the European Community
ISO	International Organization for Standardization
JSON	JavaScript Object Notation
KML	Keyhole Markup Language
OGC	Open Geospatial Consortium
REST	Representational State Transfer
SDI	Spatial Data Infrastructure
SOA	Service-Oriented Architecture
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Map Service
XML	Extensible Markup Language