EnviroGRIDS White paper:

INSPIRE tools – a quick overview

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1. INSPIRE

Website: http://inspire.jrc.ec.europa.eu/

INSPIRE Geoportal: http://www.inspire-geoportal.eu/

INSPIRE Forum: http://inspire-forum.jrc.ec.europa.eu/

The Infrastructure for Spatial Information in the European Community, namely INSPIRE, is of particular interest for the EnviroGRIDS project. INSPIRE is a European Directive (entered into force in May 2007 and fully operational by 2019) that aims to create a European Union Spatial Data Infrastructure. This will enable the sharing of environmental spatial information among public sector organizations and better facilitate public access to spatial information across Europe. When fully implemented, it will, theoretically enable data from one Member State to be seamlessly combined with data from all other States. This is particularly important for activities relating to the environment.

The main purpose of INSPIRE is to support the formulation, implementation, monitoring, and evaluation of Community environmental policies. Therefore the spatial information considered under the directive is extensive and includes a great variety of topical and technical themes and will be based on Spatial Data Infrastructures established and operated by the Member States.

This initiative wishes to overcome the barriers affecting data access and exchange in Europe, including:

- Inconsistencies in collection of geospatial data: geospatial data are often missing and/or incomplete, or are collected twice by different organizations.
- Lacking of documentation, description (metadata) of the data.
- Geospatial data are often incompatible and thus cannot be combined.
- Infrastructures used to find, access and use geospatial data often function in isolation and are incompatible.
- Barriers to sharing: cultural, linguistic, institutional, financial and legal.

In order to overcome these barriers, it has been recognized that it would be necessary to develop a legislative framework asking the Member States to coordinate their activities and to agree on a set of requirements, common standards and processes. In consequence, INSPIRE is unique in the sense that it is an important collaborative and participative process to formulate the directive, create implementing rules and develop relative specifications and services.

INSPIRE seeks to create a European SDI and the INSPIRE Directive defines it: *"infrastructure for spatial information means metadata, spatial data sets and spatial data services; network services and technologies; agreements on sharing, access and use; and coordination and monitoring mechanisms, processes and procedures, established, operated or made available in accordance with this Directive"*.

The end users of INSPIRE include policymakers, planners and managers at the local, national and regional levels, and the citizens and their organizations.

INSPIRE is based on common principles:

1. Data should be collected only once and kept where it can be maintained most effectively.
2. It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.
3. It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes.
4. Geographic information needed for good governance at all levels should be readily and transparently available.
5. Easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

A step-by-step approach is used to implement and develop the infrastructure because such an initiative cannot be built from one day to another and is asking Member States to drastically change their existing infrastructure. Thus the implementation of services has been stated just after the adoption of the Directive, whereas the harmonization of INSPIRE data themes will be made in three phases up to 2013.

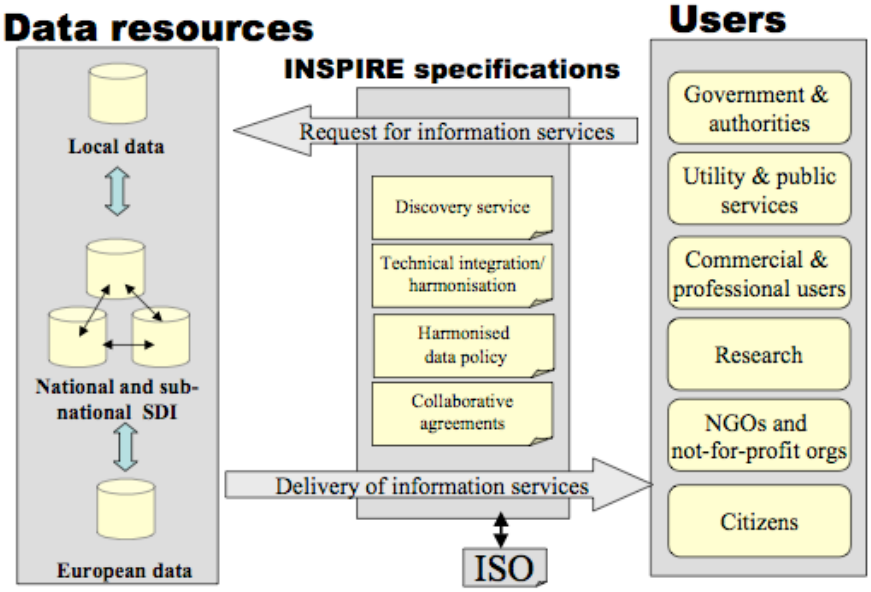
The European Commission Joint Research Center (JRC) plays a major role in this initiative as it has supported the development of the proposal and now endorses the responsibility of the overall technical coordination of the Directive, providing support to the preparation of the technical rules on implementation, data harmonization, documentation and the required services to discover, view and download data.

The Directive provides five sets of Implementing Rules (IR) that set out how the various elements of the system (metadata, data sharing, data specification, network services, monitoring and reporting) will operate and to ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and transboundary context. The Drafting Teams now working on these IRs are composed of international experts and the process includes open consultation – particularly with Spatial Data Interest Communities (SDIC) and Legally Mandated Organizations (LMO).

The Directive specifically states that no new data will need to be collected. However it does require that two years after adoption of the Implementing Rules for data sets and their related services each Member State will have to ensure that all newly collected spatial data sets are available in conformity with the IR. Other data sets must conform to the Rules within 7 years of their adoption. Implementing Rules will be adopted in a phased manner between 2008 and 2012 with compliance required between 2010 and 2019.

The envisioned interoperability in INSPIRE is a possibility offered to the user to combine geospatial data and services from different sources across the European Community in a consistent way without involving specific efforts of humans or computers. Thus users

will spend less time and efforts to integrate data delivered within the INSPIRE framework.



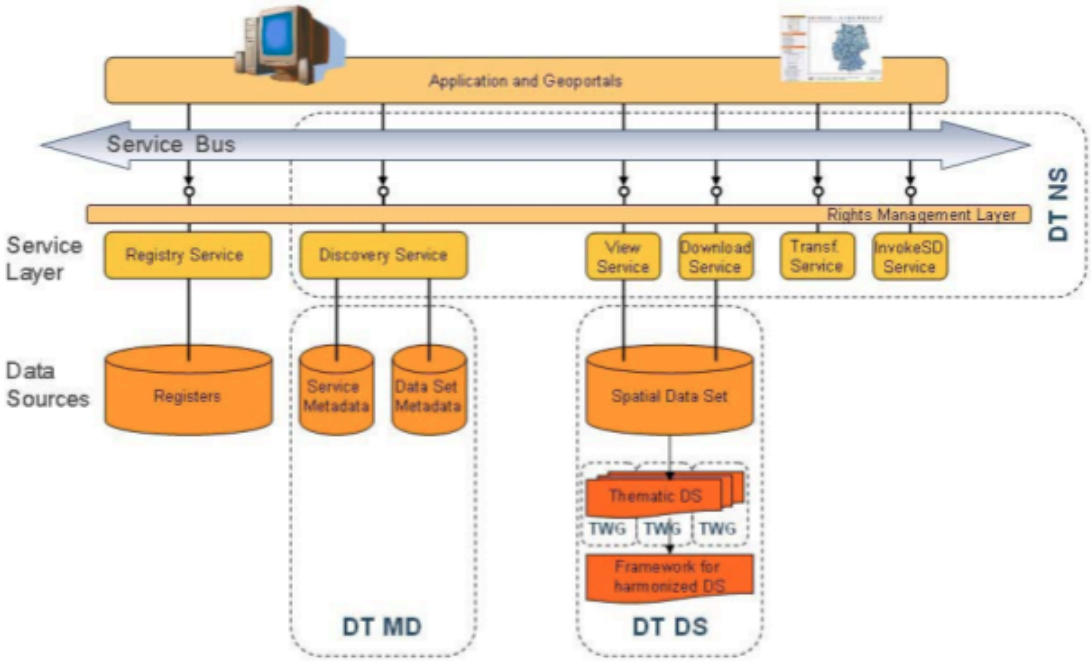
Data and information flow within the INSPIRE framework (Source: INSPIRE)

The Directive defines 34 "spatial data themes" that have been defined in three Annexes sorted in order of priority. Annex 1 datasets cover the 'basic' spatial building blocks such as spatial referencing systems, geographic names, addresses, transport networks, hydrography and land parcels. Because of the range of data types involved, the impact of INSPIRE is comprehensive. Annex 1 datasets have to be prepared and made available from 2011, with the other Annexes at later dates. In order to enable full system interoperability across the EU, each spatial data theme is described in a data specification. As mentioned on the INSPIRE website *"The process for developing harmonized data specifications is designed to maximize the re-use of existing requirements and specifications, in order to minimize the burden for Member States' organizations at the time of implementation. The consequence of this is that the process of developing Implementing Rules for interoperability of spatial datasets and services may be perceived as being complex: it involves a large number of stakeholders, with many interactions and consultations"*.

Finally, all the data, information and services shared within INSPIRE would be accessible through the INSPIRE Community Geoportal. This geoportal will not store or maintain data and metadata. Instead, it could be seen as a gateway aggregating a number of instances of specific geospatial information services distributed across the Europe and maintained by the organization responsible for the data.

According to the INSPIRE network architecture, Member States shall establish, operate and provide access to the following network services:

- *discovery services:* support discovery of data, evaluation and use of spatial data and services through their metadata properties
- *view services:* as a minimum, display, navigate, zoom in/out, pan, or overlay spatial data sets and display legend information and any relevant content of metadata.
- *download services:* enabling copies of complete spatial data sets, or parts of such sets, to be downloaded.
- *transformation services:* enabling spatial data sets to be transformed (projection and harmonization).
- *invoke spatial data services:* enabling data services to be invoked.



INSPIRE network architecture (Source: INSPIRE)

The INSPIRE Directive addresses 34 spatial data themes needed for environmental applications. These themes are subdivided in the three annexes of the directive.

Annex I	**Annex III**
1 Coordinate reference systems 2 Geographical grid systems 3 Geographical names 4 Administrative units 5 Addresses 6 Cadastral parcels 7 Transport networks 8 Hydrography 9 Protected sites	1 Statistical units 2 Buildings 3 Soil 4 Land use 5 Human health and safety 6 Utility and governmental services 7 Environmental monitoring Facilities 8 Production and industrial facilities 9 Agricultural and aquaculture facilities 10 Population distribution and demography 11 Area management/restriction/regulation zones & reporting units 12 Natural risk zones 13 Atmospheric conditions 14 Meteorological geographical features 15 Oceanographic geographical features 16 Sea regions 17 Bio-geographical regions 18 Habitats and biotopes 19 Species distribution 20 Energy Resources 21 Mineral Resources
Annex II	
1 Elevation 2 Land cover 3 Orthoimagery 4 Geology	

2. Tools supporting INSPIRE Implementing Rules

A good presentation explaining what does it means and what is required to be INSPIRE compliant: http://www.gsdi.org/gsdiconf/gsdi12/slides/1.1a.pdf

Currently there is a lot of software that implement some of INSPIRE Implementing Rules (IR). Hereafter you will find a selection of tools that are widely accepted in the GI community and that can provide a solid ground to reach the objective of INSPIRE compliance.

2.1 Metadata publishing

2.1.1 GeoNetwork

GeoNetwork is a catalog application to manage spatially referenced resources. It provides powerful metadata editing and search functions as well as an embedded interactive web map viewer. It is currently used in numerous Spatial Data Infrastructure initiatives across the world.

GeoNetwork has been developed to connect spatial information communities and their data using a modern architecture, which is at the same time powerful and low cost, based on the principles of Free and Open Source Software (FOSS) and International and Open Standards for services and protocols (a.o. from ISO/TC211 and OGC).

The software provides an easy to use web interface to search geospatial data across multiple catalogs, combine distributed map services in the embedded map viewer, publish geospatial data using the online metadata editing tools and optionally the embedded GeoServer map server. Administrators have the option to manage user and group accounts, configure the server through web based and desktop utilities and schedule metadata harvesting from other catalogs.

- Website: http://geonetwork-opensource.org/
- Documentation: http://geonetwork-opensource.org/docs.html
- Download: http://geonetwork-opensource.org/downloads.html
- GeoNetwork INSPIREd capabilities: http://geonetwork-opensource.org/manuals/2.6.4/users/search.html?check_keywords=yes&area=default&q=inspire&x=0&y=0
- An excellent report on "INSPIRE support in GeoNetwork": http://www.neogeo-online.net/blog/wp-content/uploads/2011/01/201012_geonetwork_inspire.pdf

2.1.2 Micka

MicKa is a complex system for metadata management used for building Spatial Data Infrastructure (SDI) and geoportal solutions. It contains tools for editing and management of metadata for spatial information, web services and other sources (documents, web sites, etc.). It includes online metadata search engine , portrayal of spatial information and download of spatial data to local computer.

MIcKA is compatible with obligatory standards for European SDI building (INSPIRE). Therefore it is ready to be connected with other nodes of prepared network of metadata catalogues (its compatibility with pilot European geoportal is continuosly tested).

- Website:http://www.ccss.cz/en/?menuID=49&articleID=76&action=article&presenter=ArticleDetail

2.1.3 European Open Source Metadata Editor (EUOSME)

The European Open Source Metadata Editor (EUOSME) is a web application written in Java and based on Google Web Toolkit (GWT) libraries. EUOSME has been developed as part of the EuroGEOSS project (www.eurogeoss.eu) to help create metadata compliant with the INSPIRE Directive (2007/2/EC) and the INSPIRE Metadata Regulation (1205/2008).

This editor builds on the experience acquired in the development of the INSPIRE Metadata Implementing Rules, and includes the INSPIRE Metadata Validator Service available from the INSPIRE EU Geo-portal (http://www.inspire-geoportal.eu/).

- Website & download: http://forge.osor.eu/projects/euosme/

2.2 Data publishing

2.2.1 GeoServer

GeoServer is an open source software server written in Java that allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards.

Being a community-driven project, GeoServer is developed, tested, and supported by a diverse group of individuals and organizations from around the world.

GeoServer is the reference implementation of the Open Geospatial Consortium (OGC) Web Feature Service (WFS) and Web Coverage Service (WCS) standards, as well as a high performance certified compliant Web Map Service (WMS). GeoServer forms a core component of the Geospatial Web.

- Website: http://www.geoserver.org

- Documentation: http://docs.geoserver.org/
- Download: http://geoserver.org/display/GEOS/Download
- INSPIRE extension doc: http://docs.geoserver.org/stable/en/user/community/inspire/index.html
- INSPIRE extension download: http://files.opengeo.org/inspire/
- INSPIRE view service and Geoserver: http://blog.opengeo.org/2011/07/12/inspire-update/

2.2.2 MapServer

MapServer is a popular Open Source project whose purpose is to display dynamic spatial maps over the Internet. It supports OGC WMS, WFS, and WCS standards.

- Website: http://www.mapserver.org
- Documentation: http://mapserver.org/documentation.html
- Download: http://mapserver.org/download.html
- An excellent report on "INSPIRE support in MapServer": http://www.neogeo-online.net/blog/wp-content/uploads/2011/04/MAPSERVER_INSPIRE.pdf

2.2.3 Deegree

Deegree is a comprehensive geospatial software package with implementations of OGC Web Services like WMS and WFS, a geoportal, a desktop application, security mechanisms, and various tools for geospatial data processing and management.

Additionally, deegree inspireNode provides INSPIRE View and Download Services (deegree mapService and deegree featureService) based on the advanced application schema support of deegree 3.

- Website: http://www.deegree.org/
- Documentation: http://wiki.deegree.org/deegreeWiki/deegree3
- Download: http://www.deegree.org/deegree/portal/media-type/html/user/anon/page/default.psml/js_pane/download
- inspireNode: http://wiki.deegree.org/deegreeWiki/InspireNode?action=show&redirect=deegree3%2FInspireNode

2.2.4 ArcGIS INSPIRE extension

ArcGIS provides a powerful and comprehensive SDI solution that now includes capabilities to ensure INSPIRE compliance supporting data, services, and metadata, which are delivered in the new ArcGIS for INSPIRE.

ArcGIS for INSPIRE helps meet INSPIRE compliance in a timely manner by extending the ArcGIS software that already exists in your organization. It provides View, Download, Discovery services, and Annex I data models

- Website: http://www.esri.com/software/arcgis/arcgis-for-inspire/index.html
- Whitepaper: http://www.esri.com/library/whitepapers/pdfs/arcgis-for-inspire.pdf

2.3 Data transformation

2.3.1 FME

The FME technology platform makes it easier to handle the diverse range of spatial data formats and evolving standards make interoperability such a challenge. With a unified view of your spatial and non-spatial data, you can better meet business goals and required standards, generating new insight across the organization. Solve more spatial data transformation challenges than with any other technology: transform more than 250 spatial and non-spatial formats, unlimited flexibility to restructure, reformat, and integrate your spatial data, answers the complete range of spatial data interoperability challenges with a single platform.

- Website: http://www.safe.com
- FME solution for INSPIRE: http://www.safe.com/solutions/for-initiatives/inspire/
- Data transformation: http://www.conterra.de/en/products/fme/desktop/desktop-inspire-solution.shtm
- SpatialWorld: http://www.spatialworld.fi/public/fme/en/inspire.shtml

2.3.2 SnowFlake GO publisher

The GO Publisher product range, enables you to publish data stored in your database to open standards including GML, KML and XML. This allows to translate and/or publish data to open standards, publish to INSPIRE compliant data specifications, translate your data on INSPIRE Annex I specification.

- Website: http://www.snowflakesoftware.co.uk/products/gopublisher/index.htm
- Community Edition & download: http://www.snowflakesoftware.co.uk/products/gopublisher/desktop/community/index.htm

2.3.3 INSPIRE FOSS

This project aims to provide reusable Free and Open Source Software (FOSS) components for implementing INSPIRE, specifically: ETL (Extract, Transfer, Load) : converting national geodata to INSPIRE-compliant data, storage: data(base) storage models for INSPIRE data, web services: setting up WFS/WMS/CSW/WPS to support INSPIRE network services

- Website & download: http://code.google.com/p/inspire-foss/

2.3.4 Humboldt

The technical goal of HUMBOLDT is to support Spatial Data Infrastructure (SDI) enablement by providing the functionalities for covering the data hamonisation process as a whole. The HUMBOLDT Tools and Services are built on current state of the art and standards, designed to provide solutions to all types of users, data custodians as well as private end-users. HUMBOLDT enables the use of single functionalities as part of your own infrastructure.

- Website: http://www.esdi-humboldt.eu/home.html
- Downloads: http://community.esdi-humboldt.eu/

3. Overview table

This table compares and summarizes the different tools to the various INSPIRE services that need to be implemented.

	Discovery	View	Download	Transform
GeoNetwork	YES	PARTIAL	PARTIAL	NO
Micka	YES	NO	NO	NO
EUOSME	YES	NO	NO	NO
GeoServer	NO	YES	YES	NO
MapServer	NO	YES	YES	NO
Deegree	YES	YES	YES	YES
ArcGIS	YES	YES	YES	YES
FME	NO	PARTIAL	PARTIAL	YES
GO publisher	NO	NO	NO	YES
INSPIRE FOSS	NO	YES	YES	YES
Humboldt	NO	PARTIAL	PARTIAL	YES

4. Conclusions

The tools that are mostly used and that are promoted within enviroGRIDS, namely GeoNetwork, Micka, GeoServer and ArcGIS, propose already good support for INSPIRE compliance in term of discovery, view, and download services. The main issue concerns data models compliance and related transformation service.

Other tools like EUOSME, GO publisher, Deegree, FME or Humboldt appear promising and can offer good support to comply with INSPIRE IR.

We recommend referring to software documentation in order to know exactly what to do to comply with INSPIRE.

In a more general context, we can conclude that:

- **Discovery service:** available solutions allow writing and publishing INSPIRE-compliant metadata (through desktop and web-based clients).
- **View service:** current software solutions offer already good support of INSPIRE-compliant view service (e.g. WMS 1.3.0, service metadata).
- **Download service:** software solutions offer also good support. However it is still not fully INSPIRE-compliant (e.g. performances, service metadata).
- **Transformation service:** this is the biggest issue as this service depends on INSPIRE data models that are not yet fully finalized (for Annex II and III). Currently only Annex I is supported is some software implementations. Additionally, solutions to transform data in INSPIRE-compliant data (e.g., schema mapping) are only partially supported.

  This situation will positively evolve in the near future and solutions to achieve INSPIRE-compliant transformation service will be available for all Annexes.