ArcGIS® for INSPIRE

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ArcGIS for INSPIRE

An Esri White Paper

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ArcGIS for INSPIRE

Introduction

Purpose of This Paper

This document introduces ArcGIS® for INSPIRE—an Esri® product engineered to align ArcGIS geographic information system (GIS) software with the technical standards and requirements of the Infrastructure for Spatial Information in Europe (INSPIRE).

Specifically, this document describes the functional scope of ArcGIS for INSPIRE and how it supplements core ArcGIS functionality to provide European Union (EU) Member States, agencies, and constituent organizations with an INSPIRE-compliant ArcGIS solution for their geospatial information activities. The information presented is intended to provide a basic overview and frame of reference for further technical inquiry and discussion.

Organization of This Paper

The EU vision for INSPIRE and the EU requirements framework for development of an INSPIRE-compliant GIS are both outlined at the outset of this document. In that context, an overview of ArcGIS for INSPIRE and how it supplements the ArcGIS family of technologies to provide INSPIRE-compliant GIS solutions is presented. The document concludes with the identification of sources for more information about ArcGIS for INSPIRE.

INSPIRE

Background

In general, web-based spatial data infrastructures (SDI) such as INSPIRE consist of institutional and technical frameworks for the creation, exchange, and use of geospatial information throughout an information-sharing community. Such frameworks can be implemented narrowly to enable the sharing of geospatial information within an organization or broadly to enable the sharing of geospatial information at national, regional, or global levels. In all cases, spatial data infrastructures provide a coherently managed means for posting, discovering, evaluating, and exchanging geospatial information by participating information producers and users.

INSPIRE is the EU-sanctioned spatial data infrastructure for the European Community. The purpose of INSPIRE is to tie European geospatial information producers and users together in a single, geospatial information-sharing network to improve decision making and operations in service of a productive and sustainable Europe. The target users of INSPIRE include European Community policy makers, planners, and managers and their organizations along with commercial businesses and the general European public.

Mandate and Implementing Rules

INSPIRE is chartered by an official EU directive that binds EU Member States in a common spatial data infrastructure-building effort.

The INSPIRE Directive was legislated by the EU and entered into force on May 15, 2007. The directive requires EU Member States to meet INSPIRE implementation milestones within specified time periods and leaves Member States to determine their own processes and legislative means for doing so.

Since then, the EU has proceeded with the specification and implementation of the technologies and other resources that will enable it to manage and operate INSPIRE at the EU level. At the same time, Member States have themselves been engaged with implementing state-level legislation, policies, institutional assignments, and technologies that will form the underpinnings for their Member State INSPIRE-compliant geographic information system implementations.

To guide these Member States and other INSPIRE constituent implementations—and to ensure full functional integration with the EU-wide INSPIRE network in accordance with the INSPIRE Directive—a systematic EU effort to define and prepare INSPIRE implementing rules and requirements was undertaken. The rules and requirements continue to be developed with guidance from the Joint Research Centre (JRC) of the European Commission (the Spatial Data Infrastructures Unit of the Institute for Environment and Sustainability of the JRC in Ispra, Italy).

INSPIRE rules and requirements include specifications for implementing geospatial information-sharing technology and for institutionalizing geospatial information-sharing responsibilities. Implementing rules and requirements pertaining to technology consist of specifications for metadata, interoperability of spatial datasets and services, and network services. Implementing rules and requirements pertaining to institutional responsibilities consist of specifications for data sharing, monitoring, and reporting activities.

The status of implementing rules and requirements is as follows:

Rules and Requirements Pertaining to Technology

- **Metadata—**The implementing rules for creation and maintenance of metadata were published in December 2008 in the form of a regulation that binds all EU Member States without the need of transposition in national law. Each EU Member State is required to create and maintain metadata in accordance with the technical specifications included in the regulation by the deadlines established and mandated in the INSPIRE Directive. The purpose of these implementing rules and specifications is to ensure that all geospatial information resources and datasets produced and made available by Member States and their constituent organizations are cataloged in a standard way to support a consistent means of discovery, understanding, and access throughout the INSPIRE information-sharing community.

- **Interoperability of spatial datasets and services—**Implementing rules for the interoperability of spatial datasets and services are in various stages of development and review. These rules pertain to both the content of a basic set of data themes that each Member State is required to maintain and the technological standards for communication of those data themes for use by INSPIRE constituents. The basic set of data themes is identified in annexes to the INSPIRE Directive. The regulation implementing Annex I (first of three) data themes was finalized December 10, 2010. Regulations for implementation of Annex II and Annex III data themes are currently

in development. These regulations will enable full data use and interoperability throughout the INSPIRE network.

- **Network services—**Implementing rules and regulations concerning the web-accessible services required to make spatial data obtainable and usable by Member States (including services that enable discovery, viewing, downloading, and data transformation) have been finalized. In particular, the regulation for Discovery and View Services was published in October 2009, and the regulation for Download and Transformation Services was published in December 2010. The work on technical specifications for invoking network services proceeded based on the final regulations.

Rules and Requirements Pertaining to Institutional Responsibilities

- **Data sharing—**A final regulation and corresponding technical guidance that specify Member State policy implementation measures that are required to legally enable sharing of their spatial datasets and services via the INSPIRE network were published in March 2010.

- **Monitoring and reporting—**Implementing rules for monitoring the deployment and use of each Member State's infrastructure for spatial information and for reporting status findings to the European Commission have been finalized and published. These rules stipulate quantitative indicators for assessing the progress of SDI implementation in the EU Member States and outline the structure of qualitative reports.

ArcGIS for INSPIRE

Background

ArcGIS for INSPIRE advances and enhances Esri's proven ArcGIS technology base for use by EU Member States and other EU constituent organizations to meet the INSPIRE requirements.

With ArcGIS for INSPIRE, each INSPIRE stakeholder—whether at the EU level, EU Member State level, or regional governmental and constituent organization levels—can now synchronize independent ArcGIS software-based geospatial information activities with mandated INSPIRE operations.

Scope of Functionality

ArcGIS for INSPIRE brings ArcGIS into full compliance with INSPIRE rules and requirements pertaining to

- **Creation and maintenance of metadata—**ArcGIS for INSPIRE extends existing ArcGIS for Desktop functionality to enhance the creation and maintenance of INSPIRE-compliant metadata for publication in an INSPIRE-compliant discovery geoportal.

- **Interoperability of spatial datasets and services—**ArcGIS for INSPIRE provides geodatabase templates that support creation of INSPIRE-compliant spatial datasets; enabling extraction, transformation, and loading (ETL) of geospatial information from *existing* databases into INSPIRE Annex I data models *without requiring a transformation service*, as well as creation and maintenance of *new* INSPIRE-compliant geodatabases using ArcGIS for Desktop.

- **Network (web-accessible) services—**ArcGIS for INSPIRE provides services necessary for discovery, viewing, downloading, and data transformation.

  - Network services for discovery—ArcGIS for INSPIRE provides Esri Geoportal Server configured to deliver INSPIRE-compliant metadata publishing, cataloging, and searching functionality.

  - Network services for viewing and downloading—ArcGIS for INSPIRE extends ArcGIS for Server to provide viewing and downloading capabilities in conformance with INSPIRE network service rules and requirements.

  - Network services for data transformation—This service capability is not required in ArcGIS for INSPIRE because the viewing and downloading service capabilities provided directly access INSPIRE-compliant datasets created using the ArcGIS for INSPIRE geodatabase template (see above).

In short, the ArcGIS for INSPIRE product includes

- An **ArcGIS for Desktop extension** to create and maintain INSPIRE-compliant spatial data and metadata

- An **ArcGIS for Server extension** to serve INSPIRE-compliant view and download services

- INSPIRE-compliant **geodatabase templates** for extracting, transforming, and loading geospatial information from existing databases into INSPIRE-compliant geodatabases

- The open source **Esri Geoportal Server** including enhancements for cataloging and publishing INSPIRE-compliant metadata and providing INSPIRE-compliant discovery services

By extending ArcGIS as outlined above, ArcGIS for INSPIRE enables European ArcGIS users to operate in full compliance with INSPIRE technical requirements.

Relationship to ArcGIS

ArcGIS includes tools for authoring data, maps, and globes on the desktop; publishing them to a GIS server and/or sharing them online; and using them on the desktop, on the web, or in the field.

Regardless of the scale at which it is deployed—from local desktop to global enterprise—ArcGIS technology provides the following capabilities:

- **Data management—**ArcGIS can organize and manage any amount of geographic information to support visualization and analytics applications. Users can securely store and manage spatial information and propagate data changes between multiple data sources.

- **Spatial analysis—**ArcGIS provides a complete set of tools for modeling geographic information to support smarter, faster decisions. Users can implement comprehensive spatial modeling and analysis tools to automate workflows and reveal trends and patterns in data.

- **Mapping—**ArcGIS delivers powerful visualization and cartographic mapping tools for business and scientific use: interact with data; visualize change over time and space; identify patterns and trends; and disseminate this knowledge to analysts, decision makers, and field-based personnel.

ArcGIS for INSPIRE makes ArcGIS INSPIRE-compliant. Deployed with established ArcGIS technologies, ArcGIS for INSPIRE enables geospatial data producers to create and serve INSPIRE-compliant geospatial data to the European data sharing community via the web and enables INSPIRE geospatial data users to capture that information and use it in their local enterprise GIS environment, GIS desktop environment, or most browser environments.

Figure 1 provides a conceptual architecture highlighting ArcGIS for INSPIRE and shows how it extends ArcGIS to create a complete GIS solution for participation in INSPIRE.

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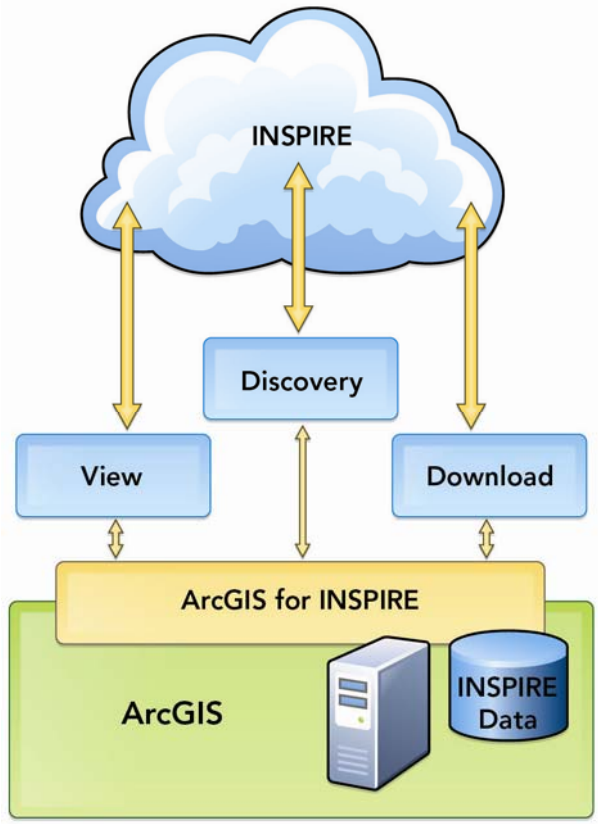
Figure 1
Relationship of ArcGIS for INSPIRE to ArcGIS Platform



Core Elements of an INSPIRE-Compliant ArcGIS Solution

ArcGIS for INSPIRE supplements and extends established ArcGIS technology as described in the following section.

Overview

ArcGIS for INSPIRE—when deployed with a select set of established ArcGIS products—meets all INSPIRE technical requirements and provides a basic range of GIS functionality needed to participate in the INSPIRE information-sharing community. More specifically, ArcGIS for INSPIRE fully meets the INSPIRE technical requirements when implemented in concert with ArcGIS for Desktop, ArcGIS for Server, and Esri's geodatabase tools.

The following table summarizes the enhancements ArcGIS for INSPIRE adds to established ArcGIS functionality to meet INSPIRE technical requirements:

INSPIRE Requirements for	Established ArcGIS	ArcGIS for INSPIRE Adds
Creation and maintenance of metadata	ArcGIS for Desktop	ArcGIS for Desktop extension
Interoperability of spatial datasets and services	ArcGIS for Server	Geodatabase templates for INSPIRE-compliant datasets
Network services	ArcGIS for Server	ArcGIS for Server extension *and* INSPIRE-compliant Esri Geoportal Server

The GIS functionality needed to meet INSPIRE technical requirements and participate in the INSPIRE information-sharing community is provided by an ArcGIS for INSPIRE enhanced ArcGIS solution composed of the ArcGIS components elaborated below.

ArcGIS for Desktop

Enhanced by ArcGIS for INSPIRE, ArcGIS for Desktop provides a means to manage INSPIRE data (i.e., create, edit, visualize, analyze), manage INSPIRE metadata (i.e., create, edit, validate, and publish in the geoportal), and author INSPIRE web services (i.e., create INSPIRE viewing and downloading services).

ArcGIS for Desktop thus enables individuals as well as enterprise GIS organizations to participate in INSPIRE as both data users and producers. With this capability, individuals who develop and use geospatial information at the desktop level become the broadest tier of potential INSPIRE participants.

Figures 2 through 6 illustrate selected capabilities introduced in the ArcGIS for Desktop environment for handling specific INSPIRE needs: creating and publishing metadata, authoring INSPIRE-compliant maps, and creating INSPIRE-compliant services.

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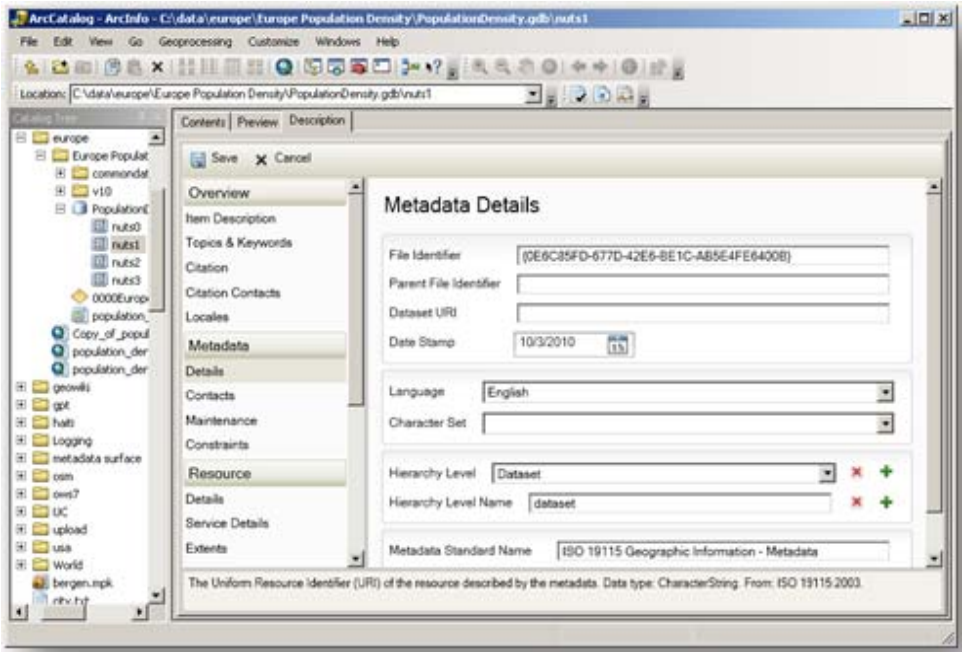
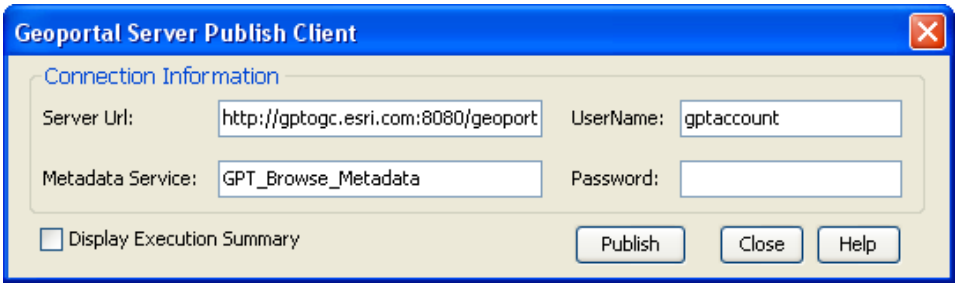
Figure 2
ArcGIS for Desktop Metadata Editor



This editor is used to create INSPIRE-compliant metadata.

Figure 3
ArcGIS for Desktop Publish Client



This function of Esri Geoportal Server is used for submitting INSPIRE-compliant metadata into the geoportal.

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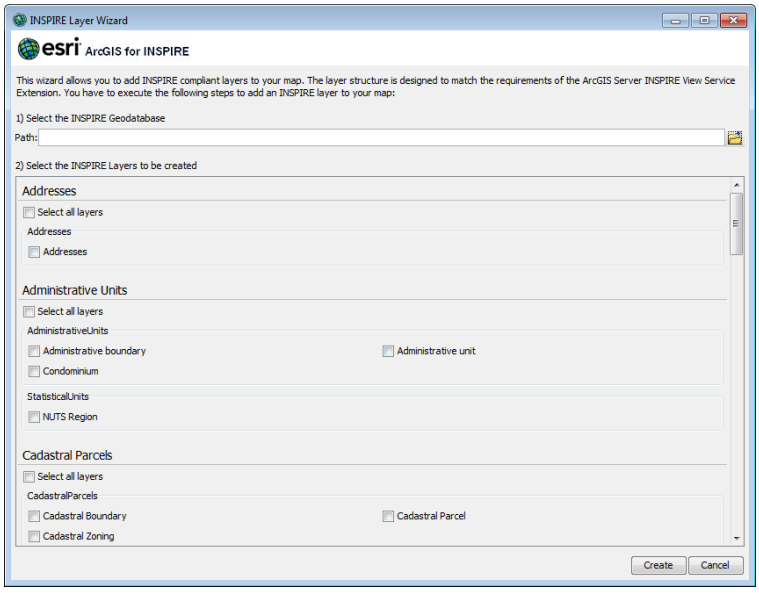
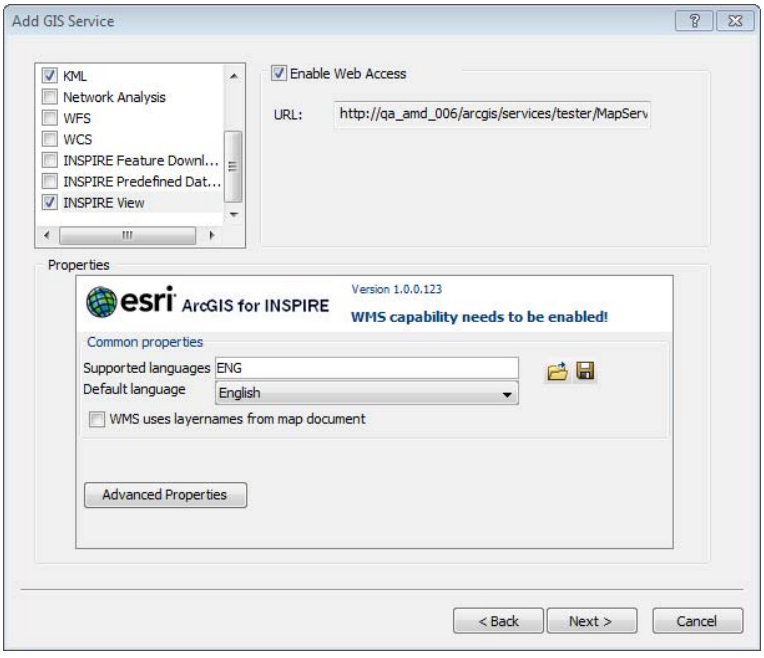
Figure 4
ArcGIS for Desktop ArcMap™ Tool



This tool automates the authoring of INSPIRE-compliant maps using data stored in the INSPIRE-compliant geodatabase models.

Figure 5
ArcGIS for Desktop ArcCatalog™ Tool



With this tool, users can publish and maintain INSPIRE-compliant network services including viewing, downloading, and predefined download feature services.

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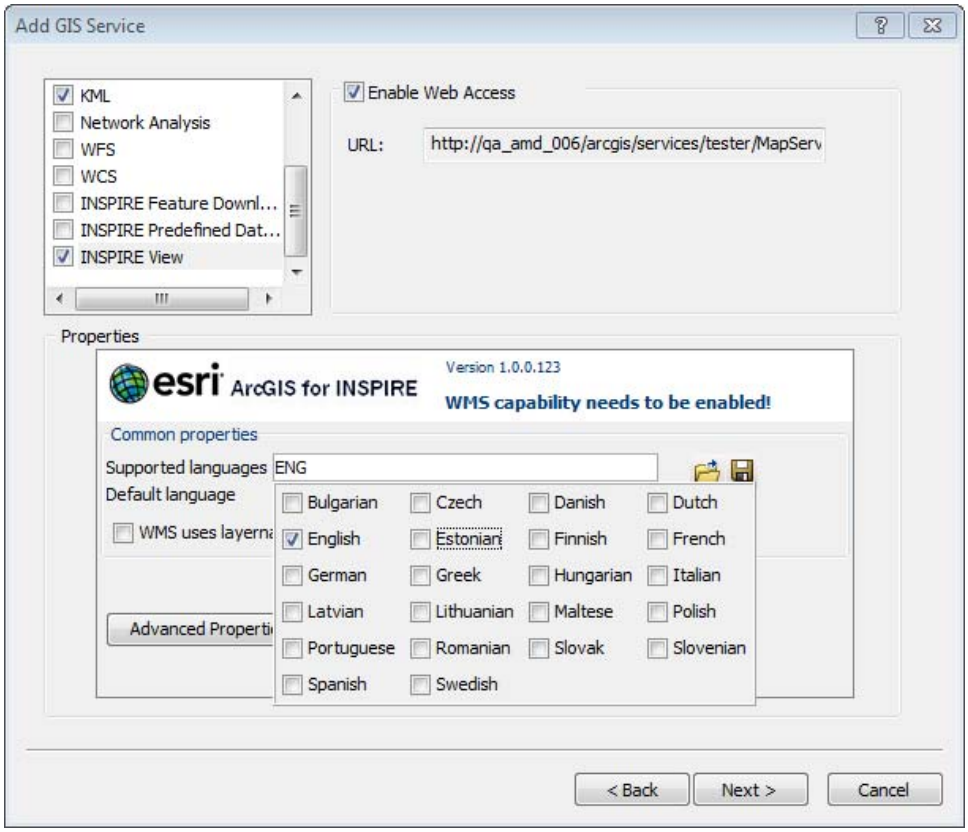
Figure 6
Add GIS Service Tool



With this desktop network service administration tool, users can designate INSPIRE-compliant language preferences.

ArcGIS for Server

ArcGIS for Server provides the ability to create, manage, and distribute GIS services over the web to support desktop, mobile, and web mapping applications. ArcGIS for INSPIRE unlocks the full range of this ArcGIS for Server technology for use in the INSPIRE context—including the capability to deploy INSPIRE-compliant view, download, and other predefined feature services.

ArcGIS for Server can be employed at the desktop or enterprise level, enabling each INSPIRE constituent to fully engage in the INSPIRE geospatial data-sharing community regardless of the scope of internal GIS operations. Using ArcGIS for Server, INSPIRE constituents can access and consume geospatial data resources they create themselves using their own desktop, mobile, or web mapping resources; access and consume geospatial data resources created and made available by other INSPIRE constituents; and serve their geospatial data resources to others via the web for use in the INSPIRE context.

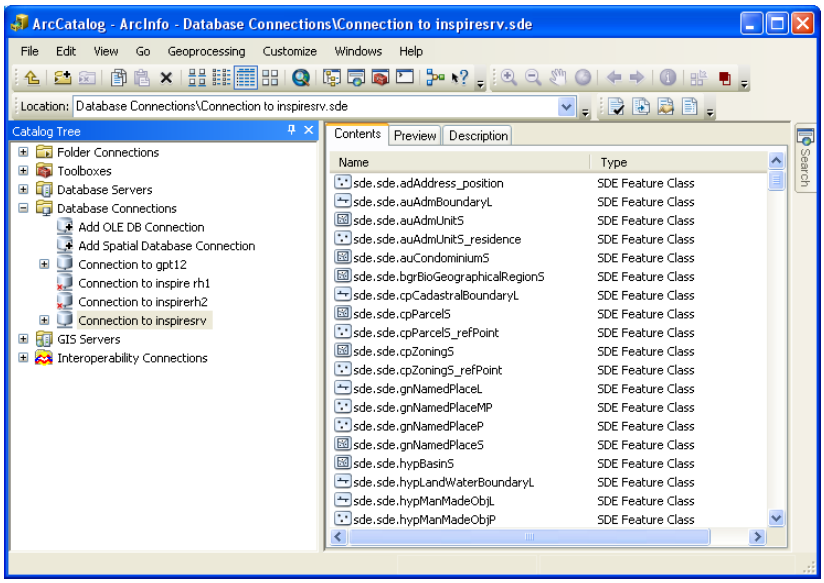
Overall, ArcGIS for Server offers the following advantages to an INSPIRE constituent government or organization:

- **Publish fast, intuitive web maps tailored to any audience**, dramatically strengthening business and resource decisions with real-time geointelligence. ArcGIS Web Mapping APIs complement this technology and support the development of web map-based applications consuming ArcGIS for Server services.
- **Geographically enable IT investments**, shrinking data and application redundancy, optimizing system configurations, and consolidating enterprise systems.
- **Centrally manage geodata**, providing better data security and integrity for an organization's most important information assets.
- **Simplify access to large volumes of imagery resources**, significantly reducing storage costs and data processing overhead.
- **Extend GIS to the mobile workforce**, increasing the accuracy and value of field data collection projects and asset monitoring as well as resource and event management.

Geodatabase Templates

ArcGIS for INSPIRE includes geodatabase templates that implement the data models for the thematic scope defined in Annex I of the INSPIRE Directive. These templates facilitate the transposition of existing datasets to the models defined by INSPIRE. Data sources based on these geodatabase templates will be leveraged by ArcGIS for INSPIRE to publish INSPIRE-compliant datasets and services.

Figure 7
ArcGIS for Desktop ArcCatalog



This screen shot shows the view and use of INSPIRE Annex I geodatabase templates.

Esri Geoportal Server

A version of Esri Geoportal Server that has been optimized to implement INSPIRE data- and service-sharing capabilities is delivered as a component of the ArcGIS for INSPIRE product.

Esri Geoportal Server provides an open source technical mechanism—a geospatial information portal—for posting, discovering, and exchanging existing geospatial information resources maintained in ArcGIS or other INSPIRE constituent GIS environments. Esri Geoportal Server can support both broadly based and more narrowly framed local and organization-specific data-sharing communities and is designed to meet INSPIRE requirements concerning discovery services and metadata. At its root, Esri Geoportal Server is an INSPIRE-compliant website-building technology designed to provide geospatial data switchboards that can be implemented for use within the INSPIRE context. It connects geospatial data producers and users by (1) enabling producers of geospatial information resources to create and post INSPIRE-compliant metadata records (citations describing their information resources); (2) enabling users of geospatial information resources to search for and discover metadata records that cite the particular resources that will be helpful to them; and (3) enabling users to preview geospatial information and access the geospatial information resources cited by the metadata records, regardless of where those information resources are stored and maintained.

A fundamental objective of Esri Geoportal Server is to provide a means for referencing and accessing geospatial information that is distributed and made available using a variety of technologies. To this end, its functionality supports all principal metadata standards and electronic data communication standards including those of INSPIRE. It can also integrate data made available in a large variety of formats.

Esri Geoportal Server supports the following standards:

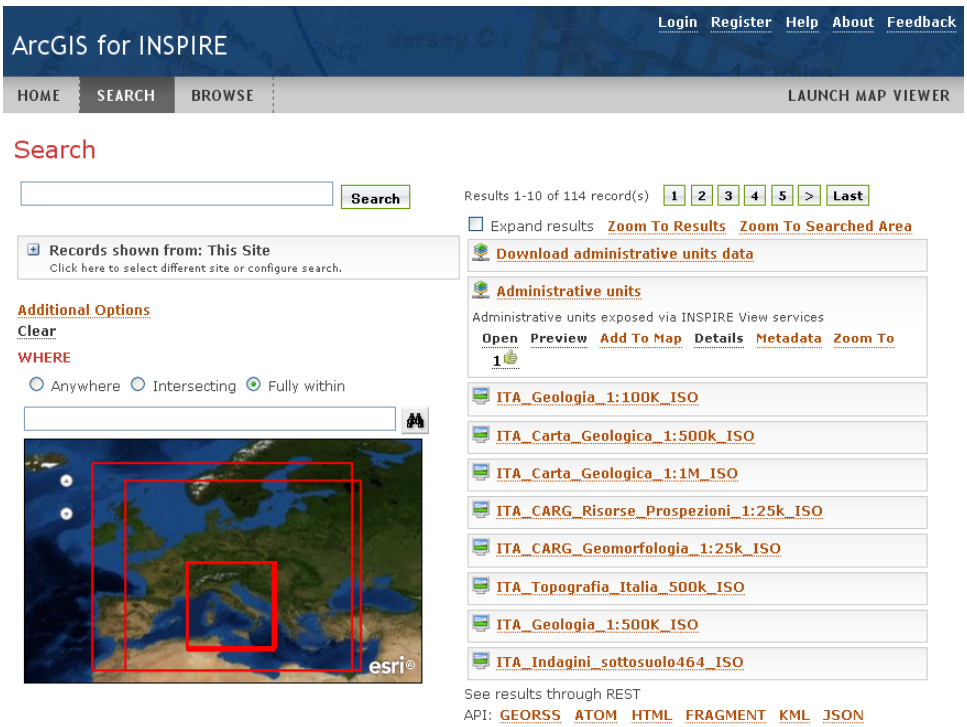
- Metadata standards: Federal Geographic Data Committee (FGDC), International Organization for Standardization (ISO) 19139/19115/19119, Dublin Core, INSPIRE, and North American Profiles
- Interface standards for integration with external map services: ArcGIS for Server; GeoRSS; KML/KMZ and Open Geospatial Consortium, Inc.® (OGC®), WMS, WFS, and WCS
- Interface standards for catalog service harvesting and to enable federated architecture: Z39.50, ArcIMS®, OAI, WAF, CSW
- Standard interfaces that enable various applications to discover resources through the geoportal: OGC CSW and CSW ISO AP, INSPIRE discovery service, OpenSearch, REST

The availability of standard interfaces supports external applications that consume geoportal services. To enable wide usage of discovery capabilities, the geoportal provides discovery clients for different environments. Additionally, interface clients are able to access the geoportal from ArcGIS for Desktop, ArcGIS Explorer Desktop, and web-based applications.

The capabilities outlined above enable INSPIRE users to create, manage, publish, and store metadata, and they include complete support for the INSPIRE discovery specification.

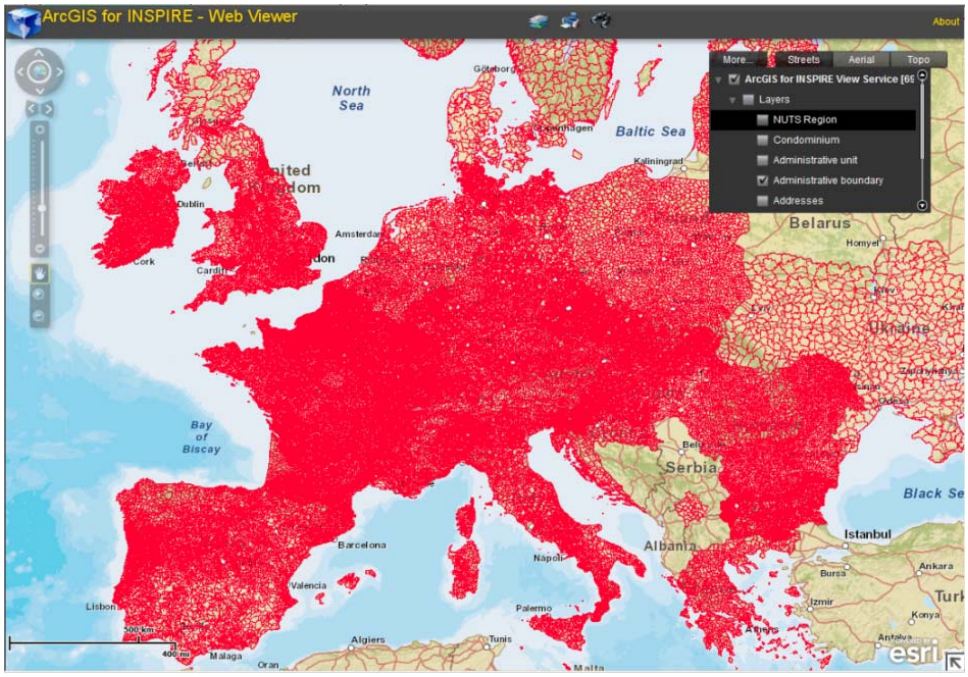
Examples of Esri Geoportal Server search result and viewer capabilities as configured and included in the ArcGIS for INSPIRE product are illustrated in figures 8 and 9.

Figure 8
Esri Geoportal Server



This shows the initial report of search results as displayed by INSPIRE-optimized Esri Geoportal Server.

Figure 9
Example of INSPIRE Geospatial Data Service



This geospatial data service was discovered by INSPIRE-configured Esri Geoportal Server and is displayed by the geoportal's Flex Viewer. (INSPIRE data consumed and displayed by the viewer is intellectual property of the European national mapping and cadastral agencies and is shown per license agreement with EuroGeographics.)

The ArcGIS technologies described above can be configured together as a complete solution for meeting INSPIRE technical requirements or with selected additional ArcGIS products and Esri partner ArcGIS software-synchronized products to exceed INSPIRE requirements in service of constituent-specific GIS objectives.

Additional Information

Experience

Examples of INSPIRE constituent systems operating or under construction today using ArcGIS for INSPIRE are identified and described on the Esri website at esri.com/esri-inspire.

Products

Additional specific information on ArcGIS for INSPIRE is available at esri.com/inspire and resources.arcgis.com/inspire.

Additional general information on ArcGIS products is available at esri.com/products.

Contact

For additional information about ArcGIS for INSPIRE or other ArcGIS products and related services or to purchase ArcGIS for INSPIRE, contact your local Esri distributor.

You can identify your local distributor in Europe at esri.com/locations.

About Esri

Since 1969, Esri has been helping organizations map and model our world. Esri's GIS software tools and methodologies enable these organizations to effectively analyze and manage their geographic information and make better decisions. They are supported by our experienced and knowledgeable staff and extensive network of business partners and international distributors.

A full-service GIS company, Esri supports the implementation of GIS technology on desktops, servers, online services, and mobile devices. These GIS solutions are flexible, customizable, and easy to use.

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Esri is a socially conscious business, actively supporting organizations involved in education, conservation, sustainable development, and humanitarian affairs.

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Printed in USA