

GEOPORTAL SOLUTIONS BASED ON ESRI GIS PLATFORM IN SOUTHEAST EUROPE

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ABSTRAKT

The concept of spatial data infrastructure (SDI) has emerged and continues to advance as a framework for organizing institutions and technology to support such geospatial information sharing. SDIs—constructed with building blocks that include enabling policy, regulatory permissions, standards, organizational structures and workflows, technical architectures, stakeholder geospatial data, metadata services, and other constituent elements—are now being implemented within and among organizations and governments throughout the world.

ESRI has long focused its technology development path on the creation of solutions that contribute to building and positioning the world's geospatial information resources for responsible and effective use. Its geoportal technology in particular has evolved to provide a technical mechanism for posting, discovering, and exchanging existing geospatial information resources in support of both broadly based SDIs and more narrowly framed local and organization-specific data-sharing communities.

As envisioned by ESRI, the role of a geoportal is to connect geospatial data producers and users by enabling producers of geospatial information resources to create and post metadata records (citations describing their information resources) and enabling users of geospatial information resources to search for and discover metadata records that cite the particular resources that will be helpful to them.

Overall, the ESRI vision is informed by the view that a geoportal is not only a mechanism for connecting parties and information but also a crossroads of technical diversity that needs to be interoperable in the sense that it enables the posting, discovery, and access of information resources regardless of underlying structures. A range of standards-based metadata formats and Web communication protocols needs to be supported, and within the geoportal itself, most mapping formats and projections should be viewable and graphically combinable.

The Republic of Croatia and Republic of Montenegro have simplified access to countrywide geographic data through an online geoportal, a type of Web site that makes it easier for citizens, government, and private-sector users to find and access vast quantities of geographic information and related services.

Key word: INSPIRE, ESRI, NSDI, GIS portal

1. INTRODUCTION

This paper describes how ESRI's ArcGIS® products and solutions-in concert with select technologies developed by ESRI business partners in Europe-provide the technical building blocks required to activate the European Union's (EU) vision for a European

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geospatial information sharing infrastructure. The information presented is intended to provide a basic overview and frame of reference for further technical inquiry and discussion.

The generic concept of spatial data infrastructures (SDI) and the EU vision for a European spatial data infrastructure are both outlined at the outset of this paper. An overview of ArcGIS SDI-building software and solutions, including ArcGIS extension technologies developed in Europe that have specific applicability to the EU vision, is presented in that context.

The term *spatial data infrastructure* was coined in 1993 by the U.S. National Research Council to denote a framework of technologies, policies, and institutional arrangements that together facilitate the creation, exchange, and use of automated geospatial data and related information resources across an information-sharing community. Such a framework can be implemented narrowly to enable the sharing of geospatial information within an organization or more broadly to enable the sharing of geospatial information at a national, regional, or global level. In all cases, an SDI will provide an institutionally sanctioned, automated means for posting, discovering, evaluating, and exchanging geospatial information by participating information producers and users.

A European SDI—known formally as the Infrastructure for Spatial Information in Europe (INSPIRE)—is envisioned and chartered by an EU directive that binds EU Member States in a common SDI-building effort.

The underlying INSPIRE concept is for an Internet-accessible infrastructure of technologies and permissions that will tie European geospatial information producers and users together in a single geospatial information-sharing community to improve decision making and operations at all levels of endeavor in service of a productive and sustainable Europe. The target users of INSPIRE include European policy makers, planners, and managers and their organizations along with the general European public.

2. ESRI GEOPORTAL TECHNOLOGY

Recent years have witnessed the rapid development and expanding use of automated mapping, geographic information system (GIS), and spatial data communication technologies and standards.

Such progress—along with the associated growth in geospatial data collection activity by organizations and governments throughout the world—has helped create a global reservoir of electronically enabled geospatial information that has real potential for improving decision making and operations at all levels of endeavor in service of a productive and sustainable future for everyone.

To help realize this potential, geospatial information resources must be positioned both institutionally and technologically for wide discovery, exchange, and use.

The concept of spatial data infrastructure (SDI) has emerged and continues to advance as a framework for organizing institutions and technology to support such geospatial information sharing. SDIs—constructed with building blocks that include enabling policy, regulatory permissions, standards, organizational structures and workflows, technical architectures, stakeholder geospatial data, metadata services, and other constituent elements—are now being implemented within and among organizations and governments throughout the world.

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Further—and importantly—ESRI envisions that the role of such a portal is also to provide the means for users to preview and access geospatial information resources cited by the metadata records, regardless of where or how those information resources are maintained. Figure 1 illustrates this basic concept.

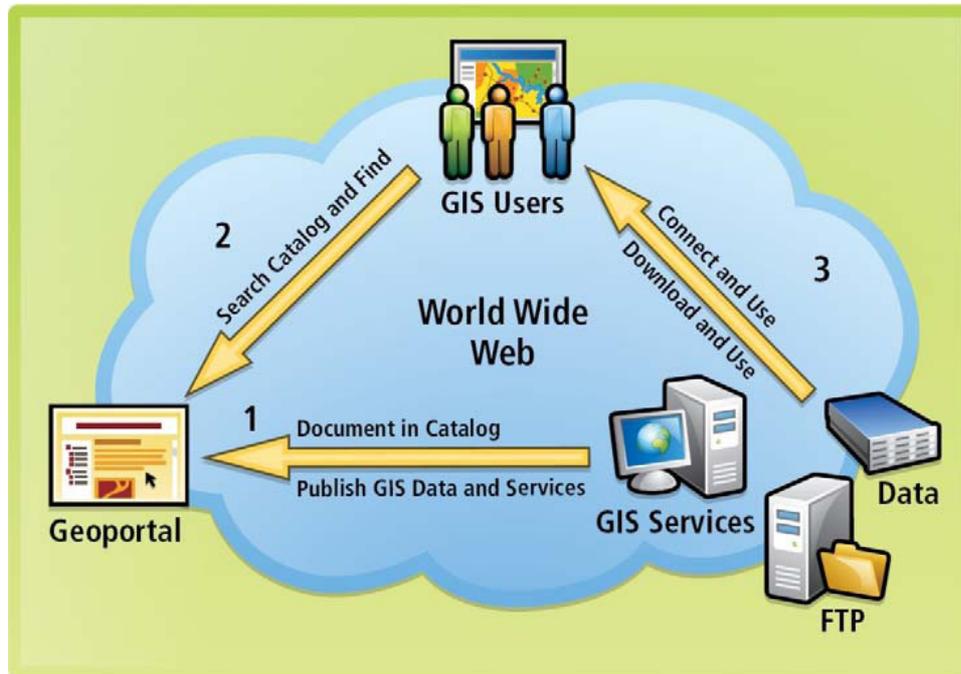


Figure 1
A Geospatial Information Portal as a Federated Service

ESRI's vision assumes that the discoverable information resources cited in the geoportal will likely consist of a wide range of information resource types. These may include not only Web-accessible maps and GIS application services but also physical maps, documents, and other information resource types that are not necessarily Web accessible.

ESRI's vision also assumes that those cited and discoverable information resources that *are* Web accessible will be made available to portal users by their producers in a variety of forms and will use a variety of communication protocols. A geoportal's functionality, therefore, needs to anticipate and support a variety of technologies and standards.

Overall, the ESRI vision is informed by the view that a geoportal is not only a mechanism for connecting parties and information but also a crossroads of technical diversity that needs to be interoperable in the sense that it enables the posting, discovery, and access of information resources regardless of underlying structures. A range of standards-based metadata formats and Web communication protocols needs to be supported, and within the geoportal itself, most mapping formats and projections should be viewable and graphically combinable.

ESRI's approach to supporting the portal-based exchange of geospatial data resources via the Web is based on an understanding that every portal will operate in unique circumstances and will be developed to address implementation-specific objectives.

In line with this basic understanding, ESRI's root concept has been to create generic software consisting of standard core functionality organized into a framework of components that are configurable by design to address each unique circumstance—and to complement that software with optional technology transfer services intended to help implementing organizations configure both the software and supporting architectures in a way that addresses their own specific needs.

The software product ESRI has developed in the context outlined above is packaged and supported by ESRI as a core ESRI product on the standard ESRI maintenance-based model.

The software itself consists of a suite of Web-based and desktop software components collectively called the **ArcGIS Server Geoportal extension**. This geoportal-building software provides a generic functionality base that, by design, anticipates implementation-specific configuration in order to enable conformance to the specific environment where it is being installed, creation of a host-specific look and feel for the interface, and activation of host-selected functionality options.

In addition to standard annual maintenance purchased with the product, ESRI provides a number of service options as follows: a developer support package designed to provide remote information and advice to licensees who seek to modify underlying software code to meet requirements that may not have been anticipated by the standard software package, a custom-scheduled on-site installation training and technology transfer program that supports the implementation of underlying architectures and helps with implementation-specific ArcGIS Server Geoportal extension configuration using out-of-the-box software.

3. ARCGIS SERVER GEOPORTAL EXTENSION FUNCTIONALITY

Functionality for End Users

The components of the ArcGIS Server Geoportal extension work together and individually to enable end users to:

Discover geospatial data resources produced by others—The ArcGIS Server Geoportal extension implements functionality that enables geoportal users to discover and select information resources that are of particular interest to them. Searching uses term-based criteria entered by the user and geographic location criteria the user designates on a map.

The results of any ArcGIS Server Geoportal extension search are displayed as summary statements derived from the metadata records citing each found information item. The user can then elect to display more detailed descriptions of each information item or the full metadata record itself.

From either the summary or detailed results displays, the ArcGIS Server Geoportal extension includes functionality that enables the user to link directly to the Web site that hosts the cited information item if that option is made available by the information item publisher, preview the information item if it is a "live" map available from a service maintained by the information item publisher, or download the information item from within the portal if that option is made available by the information item publisher.

Preview geospatial data resources produced by others—The ArcGIS Server Geoportal extension provides inline map service preview functionality that enables users to discover and view mapped data maintained on Web-accessible map services (live maps) without launching a map viewer. This ability to preview a live map is provided by a Preview button that automatically appears together with the text description of each live map.

The information the ArcGIS Server Geoportal extension requires to enable this capability is included in validated and published metadata records—if the cited information item consists of live data or maps and if it is maintained as described in the metadata on a Web-accessible server.

If users elect to examine information items other than live data or maps (for example, document files or mapped data viewable only by using an application maintained on the publisher's Web site), they can link to the Web site where a data item is maintained if that opportunity is provided by the publisher.

Make maps that combine geospatial resources produced by others using a variety of map viewer technologies—The ArcGIS Server Geoportal extension provides the capability for the implementer to plug in a map viewer technology of choice to provide end users with mapmaking functionality that integrates with other ArcGIS Server Geoportal extension functions. Map viewer technologies that can be used include Java™ Application Development Framework (ADF), JavaScript™, Flex™, and Silverlight™, to name a few.

The integration of any of these map viewers enables end users to combine mapped data from different live map sources they discover using ArcGIS Server Geoportal extension functionality, then view the composite map during the same geoportal session. The functionality available to the end user will depend on the specific map viewer that has been selected and integrated.

Figure 2
Default ArcGIS Server Geoportal Extension Search Interface

Obtain geospatial data resources produced by others—Any information item that is cited in metadata published on a geoportal based on the ArcGIS Server Geoportal extension is obtainable if the publisher of the information item makes it available. The information items can be obtained using the option to link externally to the publisher's Web site or the option to download the data from within the portal interface itself via an internal link provided by the data producer.

Search and obtain geoportal metadata records directly from external applications—The ArcGIS Server Geoportal extension includes a REST API that enables external access to geoportal metadata records. Such external access provides users with the ability to access the metadata records from a variety of applications such as RSS readers, content management systems such as SharePoint or Joomla, and wikis. Precoded geoportal search and discovery tools have been created and are packaged with the ArcGIS Server Geoportal extension and available separately from the ESRI Web site for insertion into ArcGIS Explorer and ArcMap™ desktop applications.

Receive automatic notification of new geospatial data resources that meet preestablished criteria—The ArcGIS Server Geoportal extension functionality provides end users with the ability to subscribe to a GeoRSS feed that automatically notifies the user whenever a metadata record describing a new geospatial data resource that meets user-specified criteria is published in the geoportal.

Expose one's own geospatial data resources for discovery by others—The ArcGIS Server Geoportal extension functionality enables Web-based geospatial information

producers to publish metadata describing their information if they are authorized to do so by a geoportals administrator.

Publishers on a geoportals that is built using the ArcGIS Server Geoportals extension have three basic options for posting their metadata. They can create their metadata using ArcCatalog™ or an independent XML editor and upload the records to the target geoportals, create their metadata and post it using an online metadata entry form integrated into the geoportals, or make their metadata available on a Web server and register for external harvesting by the geoportals's metadata harvesting tool.

The ArcGIS Server Geoportals extension includes out-of-the-box functionality that can be engaged to automatically validate submitted metadata records against a variety of standard metadata formats (Federal Geographic Data Committee [FGDC] Best Practices, Dublin Core, ISO 19139/19119 Web Services, ISO 19139/19115 Data Sets, and ESRI ISO) and profiles (North American Profile and Infrastructure for Spatial Information in Europe [INSPIRE]). In addition, custom metadata formats can be created, and standard metadata formats can be modified or detailed for use and validation. Publishers are informed of metadata records that fail this automatic validation. The ArcGIS Server Geoportals extension also provides functionality that enables a geoportals administrator to review and approve all technically validated metadata records before they become accessible for search and discovery.

Register as a portal user—ArcGIS Server Geoportals extension functionality provides the option for integration with external LDAP authentication solutions to enable users to register. By design, ArcGIS Server Geoportals extension functionality does not require user registration for basic search and search results viewing. The option to register via LDAP solutions, however, is provided to enable the managers of a geoportals to customize access to advanced functionality.

Functionality for Geoportals Management

Two principal management roles are anticipated by ArcGIS Server Geoportals extension functionality:

Administrator—A suite of ArcGIS Server Geoportals extension functionalities has been designed for the exclusive use of a geoportals administrator or manager. The administrator functionality enables the person or persons who manage a geoportals to approve or disapprove metadata prior to its release and undertake other related aspects of portal operations. Administrators are required to be registered users, and administrator function options are provided on the administrator's home page upon login based on the administrator's User-ID and password.

Publisher—Publisher functionality enables publishers to post and manage their metadata records using special ArcGIS Server Geoportals extension functions available only to them. Publishers are required to be registered users, and publisher function options are provided on the publisher's home page upon login based on the publisher's User-ID and password.

Functionality for Geoportals Data Security

The ArcGIS Server Geoportals extension provides functionality that enables authentication of users via most LDAP solutions and the authentication options those solutions provide. In addition, the ArcGIS Server Geoportals extension provides the option for simple authentication of a single portal administrator (with access to all geoportals functionality) if that is preferred.

Functionality for Geoportals Interoperability

A fundamental objective of the ArcGIS Server Geoportals extension 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, ArcGIS Server Geoportals extension functionality supports all principal metadata standards and electronic data communication standards. It also has capabilities that integrate data made available in a large variety of formats. Figure 3 indicates the principal points of communication and the associated data communication standards, protocols, and formats that are supported.

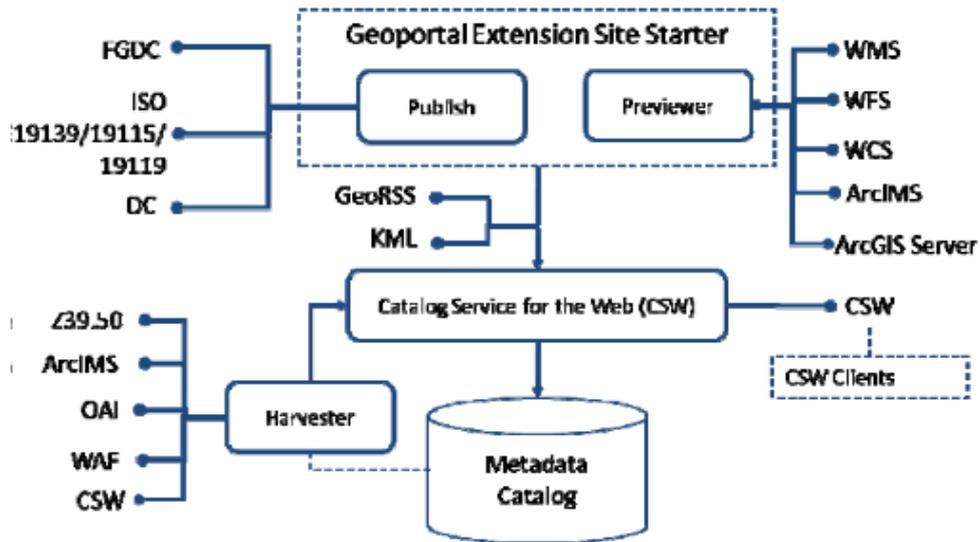


Figure 3
ArcGIS Server Geoportals 9.3.1 Extension Standards Support

Functionality for Interface Customization

The ArcGIS Server Geoportals extension anticipates customization and internationalization of the user interface elements (including both graphics and text) and implementation-specific configuration to a basemap, geocoding service, and other services. In addition, ArcGIS Server Geoportals extension components are easily configurable to fit together with supporting software and database elements within the host's unique architecture.

4. REQUIRED TECHNOLOGY

A geoportals needs supporting hardware and software in its underlying operational environment.

The specification of hardware requirements for support of a geoportals will necessarily be tied to the existing architecture of the hosting organization and the intended level of use. In general, however, common practice for running all geoportals software components is to use a minimum of two dedicated servers with Internet connectivity along with at least one desktop computer with Internet connectivity. In addition, provision of database servers within the hosting organization will be required to serve data maintained by the organization itself. Networking hardware and capacities will be dependent on the intended scale of operations for the geoportals and on the size and location of the stakeholder community. Underlying software required to support a

geoportal built with ESRI's ArcGIS Server Geoportal extension is detailed in the online. Organizations contemplating implementation of a geoportal often already have licenses for much of the needed underlying software. Nevertheless, a review of an organization's existing software and architecture, together with a review of the specific software required to support a geoportal, is recommended to determine the level of effort and expense that will be involved in preparing for implementation of a geoportal.

A geoportal is of no use without data.

To serve its purpose, a geoportal needs accessible GIS data services and high-quality, complete metadata that describes those services. Data services and other GIS data items must be maintained as described by the associated metadata. This means that data and data services must be cataloged systematically according to a metadata standard and schema designated by the geoportal host organization or stakeholder community. This data cataloging and maintenance work is ongoing, and the associated costs reflect the amount and type of data that is published using the geoportal. Since a geoportal is really about data, this data inventorying and maintenance element of geoportal support is the single most important investment required. If the metadata describing data is faulty, and if the data described is out-of-date, wrong, or only available sporadically, a perfectly functioning geoportal will be of little use. Though data can be maintained and associated metadata can be created and published on a geoportal by entities other than the portal's host organization (depending on the designated breadth of the stakeholder community), the host organization will be responsible for reviewing metadata prior to publication to ensure its completeness and conformity to established standards and schemas. Prior to geoportal installation, it is recommended that a host organization's management conduct an inventory and review of the data it currently maintains (and that its stakeholder community maintains) in order to understand the level of effort that will be involved in installing and maintaining a viable and useful geoportal.

A geoportal needs staff support.

Significant staff time is required to maintain and use a geoportal. Geoportal management requirements will vary depending on a hosting organization's intentions and the extent to which the COTS functionality of the geoportal is engaged (i.e., uniquely customized geoportal code will require more staffing to support it than a COTS-based geoportal). In all cases, however, people will be needed to perform the following roles:

- Chief information officer
- Geoportal operations manager
- Geoportal content administrator
- Geoportal metadata publishers (external and internal)
- End users

These roles need to be formalized in the context of each hosting organization's staffing arrangements and with a view toward the breadth and frequency of geoportal use. The costs of dedicating time for the geoportal management and user responsibilities can be balanced against the efficiencies realized by a fully functioning mechanism for discovery and exchange of geospatial information and the extent to which that can support the central mission and workflows of the organization itself.

A geoportal needs a training program.

A formal training program for geoportal managers and users is essential to success. Such a program will consist of both installation-phase technology transfer and the ongoing training of general users. Installation training for geoportal managers and

operations personnel is normally three to five days. User training is normally one day at the outset, with refresher sessions over time. This basic training program may be supplemented by training in cataloging (metadata creation) or other specialized geoportal-related activities. Promotion of acceptance for the geoportal at the initial stages—including provision of clear direction on how management intends the geoportal to support the work of stakeholders in the context of their workflows—can be effectively undertaken as part of a formal training program as well.

In summary, the following basic management actions are recommended prior to installing a geoportal in an organization:

- Establish an executive charter or sponsorship.
- Designate a base of operations.
- Authorize funding.
- Plan a prelaunch user outreach strategy.
- Review the required technology environment.
- Review the required data environment.
- Provide required staffing.
- Anticipate technology transfer and training.

Each organization contemplating the installation of a geoportal will need to tailor its decision-making and preparation activities to its own policies and practices. This list of recommended actions is intended to introduce such organizations to a scope of generic management issues that may inform their decision making and program for geoportal installation and operation.

5. SUGGESTIONS FOR SUCCSESFUL GEOPORTAL IMPLEMENTATION

Clear objectives based on anticipated business processes and an anticipated user population are essential to a successful geoportal implementation. The objectives are most effective when developed at a high level and independently of the question, What can the ArcGIS Server Geoportal extension software do? When objectives are clear, the capabilities of the ArcGIS Server Geoportal extension can be understood in the context of the workflow-related benefits it can provide, and it will be evident whether a geoportal built with the ArcGIS Server Geoportal extension can help provide the solution that is sought.

Fundamental to a successful ArcGIS Server Geoportal extension deployment is a clear understanding of geoportal hosting and management requirements at the outset of implementation efforts. Such requirements include underlying host system software and hardware infrastructure, the technical personnel and organizational charter for supporting it, and the dedication of appropriate management resources to maintain geoportal content both at the installation stage and during operations. The availability of the proper support resources and the willingness and funds to support them within an organization are essential to the successful development and hosting of a geoportal by an organization.

A geoportal implementation is accomplished atop a variety of essential building blocks that provide the underpinning for the successful installation, configuration, and

operation of the software. As is true with any geoportal, a geoportal based on the ArcGIS Server Geoportal extension can only succeed when these elements are in place:

Organizational sponsorship is required to initiate consideration of a geoportal and development of a plan for implementation.

People must be in place and trained appropriately to manage and grow the geoportal.

Data is required to support ArcGIS Server Geoportal extension functions and must be prepared and available in a form and technical circumstance that feeds the geoportal seamlessly.

Underlying hardware/software infrastructure must be in place and configured appropriately to support effective use of the portal.

Funds must be in place or budgeted to support the ongoing operation of the portal.

These principal elements, along with a plan for the scheduling and critical path sequencing of their implementation, represent the scope of endeavor that an organization will necessarily undertake when implementing and operating a successful geospatial information portal based on the ArcGIS Server Geoportal extension.

6. ESRI-BASED SOLUTIONS IN SOUTHEAST EUROPE TODAY

National Geo-portal for Croatia

The Croatian State Geodetic Administration (SGA) is responsible for establishing a National Spatial Data Infrastructure (NSDI). The establishment of the NSDI will promote the development of national databases and their connection into a single information system that will allow agencies to use the data effectively and complement it with their own data. To fulfill these requirements, SGA is establishing a geoportal.

Supported by the Government and based on state of art concept & technology, SGA geoportal initially provides five data sets, metadata service and many functionalities. The first release of SGA's geoportal includes the Central Registry of Spatial Units, a 1:5,000-scale orthophoto map, the 1:5,000 scale Croatian basemap, cadastral maps in raster form, and the Database of Permanent Geodetic Control Points.

Preglednik katastarskih podataka

Unesite dio imena katastarske općine

ODABERITE OREB / ISPOSTAVU

- PUK Osijek
- PUK Čakovec
- PUK Dubrovnik
- PUK Gospić
- PUK Karlovac
- PUK Koprivnica
- PUK Krapina
- PUK Osijek
- PUK Pazin
- PUK Požeга
- PUK Rijeka
- PUK Šibenik
- PUK Slavonski Brod
- PUK Split
- PUK Šibenik
- PUK Varaždin
- PUK Vukovarska
- PUK Zagreb
- OU Grada Zagreba

Dobrodošli!

Preglednik katastarskih podataka služi za uvid u središnju bazu postojećih katastarskih podataka Republike Hrvatske koja se vodi u Središnjem uredu Državne geodetske uprave. Podaci koji se vide u bazi služebi su katastarski podaci. Preglednik omogućava uvid u katastarske podatke o određenim datumom za cijelu državu. Uvid u podatke moguć je putem kraja i katastarske čestice ili putem broja posjedovnog lista u odabranoj katastarskoj općini. Ispis posjedovnog lista ima informativni karakter i ne može služiti kao javna isprava. Javne isprave izdaju se u nadležnim područnim uredima za katastar i njihovim ispostavama.

Preglednik omogućava uvid u **2.536.268** posjedovnih lista, te uvid u podatke o **16.950.034** česticama zemljišta. U posjedovnim listama evidentirano je ukupno **14.343.821** katastarskih čestica i **2.379.619** čestica.

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REPUBLIKA HRVATSKA DRŽAVNA GEODETSKA UPRAVA

Figure 4: GPT-Based SGA Geoportals Geospatial Information Search Page (Bačić, 2007)

JIS – Joint Information System of Land Registry and Cadastre, is planned to be introduced in the 2nd phase of Geoportals, while the realization of first inter-institutional NSDI based networking of systems is scheduled for mid 2009. SGA geoportals will be public driver and window of Croatian SDI and central tool for pilot projects and further development.

The Republic of Croatia has simplified access to countrywide geographic data through an online geoportals, a type of Web site that makes it easier for citizens, government, and private-sector users to find and access vast quantities of geographic information and related services. The geoportals has already proven its value as an essential component of the country's Organized Land Project, which streamlines and regulates the real property registration of land in the republic. By making data more accessible, the average time for processing changes to land titles has dropped from a 400-day average to 37 days.



Figure 5: Geoportals Geospatial Information Sample Search (<http://www.dgu.hr>, March 2009)

Gis Web portal for Montenegro - Real Estate Administration Department(READ)

Objective of Project Description is to give guidelines for the design and development of GIS Web Portal for the READ. GIS Web portal is the application solution that facilitates exchange of data between READ and the users of its services.

Following regulation forms the basis for this project description:

- Law on national survey and real estate cadastre („Službeni list RCG“, br. 29/07),
- Strategy for development of information society of Montenegro,
- Midterm program for national survey and establishment of real estate cadastre for the period 2008. – 2013.
- Instruction on digital plans, READ, 2004.
- INSPIRE directive (L 108 Volume 50, 25.04.2007.)

As a methodology for development of project specification, ISO standard Reference Model for Distributed Information Systems RM-ODP (Reference Model – Open Distributed Processing) is used. This model aligns with the architecture of proposed system, following the fact that system is highly distributed. RM-ODP is standardized by ISO and accepted by OpenGIS Consortium. Model describes system through so called views. Following views describe the system:

- Enterprise View – where the business logic of the system is described, along with organization and interaction between actors in the system. procedures for data exchange as well as general layout of GUI (Graphical User Interface) of system web pages.
- Information View – describes structure and statical data model for the data the Portal operates upon.
- Computational View – serves the purpose of describing the system as a composition of distinct functionalities.
- Technology View – defines mapping of functionalities of the Portal to different hardware and software components.

Figure 6 shows the architecture of the system. System is organized in four layers:

- Client layer – the application that user uses to communicate with the system,
- Presentation layer – the set of applications that generate controls for the client layer,

- Service layer – the set of services that define business logic for the system, that is the elementary services that are available to the user and other components in the system,
- Data layer – represents the system for persistence of data that portal operates upon.

Besides that, three components represent important integral part of the solution:

- System for management of geospatial data and cartographic processing – represents the set of tools needed for seamless input of various data in the system and quality assurance, but also the representation of data through advanced cartographic techniques.
- External services – system should be capable to consume geospatial web services served from the external users, and make them integral part of the whole system.
- Services to external consumers – the system is part of the overall e-government system of Montenegro, and therefore should enable access to geospatial services for other government applications through geospatial web services.

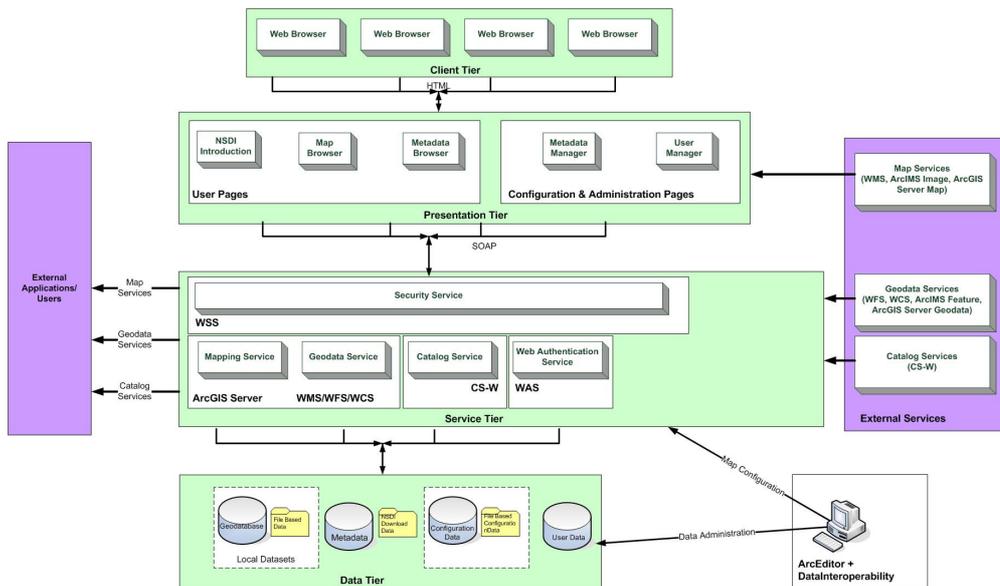


Figure 6 - Architecture of the system

Client Layer

Client layer represents an application that client uses to communicate with the system. GIS Web Portal is based on web interface, meaning that the client layer is fully based on modern web browsers such as Internet Explorer, Firefox, Opera etc. Client layer is fully based on HTML and JavaScript and does not require any plug-in.

Due to high interactivity of web pages that show dynamic maps, client layer makes extensive use of AJAX ((Asynchronous JavaScript and XML) techniques in order to eliminate the need for the whole page to refresh upon each request to the server. These techniques enable partial page refresh and reduces communication with the server to the minimum.

Presentation Layer

Presentation layer represents set of applications that generate controls for the client layer. Presentation layer uses standard HTTP communication mechanism with the client layer. Presentation layer communicates with the service layer through SOAP web services, enabling simple interaction and ability to expand solution by introducing new functionalities in the form of services.

Presentation layer is composed of two main web applications:

- User Pages are composed of three main web pages:
 - Introduction page – contain basic information about Portal, links to other pages, interface for registering and logging users, as well as language selection (Montenegrin or English).
 - Map Browser – contains interactive map of Montenegro with required layers and tools to navigate and query map,
 - Metadata Browser – contains tools for browsing/searching metadata for datasets and services, as well as visual map view of the metadata. This interface enable selection of appropriate datasets and services and their display on Map Browser.

Apart from these basic pages, User Pages application contains pages for logging existing users and registering new users.

- Administration Pages are composed of pages for managing users and pages for managing metadata.

Presentation layer is based on Java Server Pages (JSP) technology and should be implemented on Tomcat open source Servlet container.

Service Layer

Service layer represents the set of services that define the business logic of the system, that is the elementary services that available to users and the other components of the system. Following services are implemented as part of GOS We Portal:

- Security Service – provides the security of all other services from unauthorized access. Service is based on WSS (Web Security Service) standard.
- Authorization Service – provides authorization of users and implementation of all the policies when users access all the other services within the system. This service is based on WAS (Web Authorization Service) standard.
- Map Service – provides rendering of interactive maps and query functionality, as well as implementation of logic for map navigation and data searching. Service is based on OGC WMS standards and ArcGIS Server SOAP Map Service. WMS supports GML Simple Feature Profile as a format for serving vector data.
- Geodata Service – provides direct access to the geospatial data through web service interface, as well as data querying and update of locally stored data. Service is based on OGC WFS and WCS standards. WFS supports GML simple feature profile as a format for vector data.
- Metadata Catalog Service – provides access, search, browsing, editing and maintenance of metadata. Service is based on OGC CS-W standard.

Data Layer

Data layer represents the system for storage all the data that Portal operates. There are three main types of data that comprise this layer:

- Geospatial data – represent READ data that READ has decided to make available to the external users.

- Metadata – represent data that describe READ data, but also the the data of other organizations that want to make them available for the users of the GOS Web Portal.
- User Data – represent data needed for user authentication. User identification data is stored here, but also data that describe policies for service and data use by user groups.



Figure 7 - Introduction page layout

Data Management and Cartographic Processing

System for management of geospatial data and cartographic processing represent the set of tools needed for seamless input of various data into the system and data quality assurance, but also the representation of data through advanced cartographic techniques.

Consuming External Services

System is capable of consuming geospatial web services published and served by external users, and make the available as integral part of the system. For users that make their services available through the portal, Portal enables input of metadata. External services can be embedded in map services as layers of the interactive map.

Portal is capable for consuming all the standard OGS web services (WMS, WFS, WCS), as well as ArcGIS Server SOAP services.

Providing Services for External Users

System represents a component of the overall e-government system of Montenegro, and therefore should provide integration with other government services and applications through geospatial web services. Such services are secured through Security Service in order to enable access only to authorized users.

Portal is capable of serving all the standard OGS web services (WMS, WFS, WCS), as well as ArcGIS Server SOAP services.

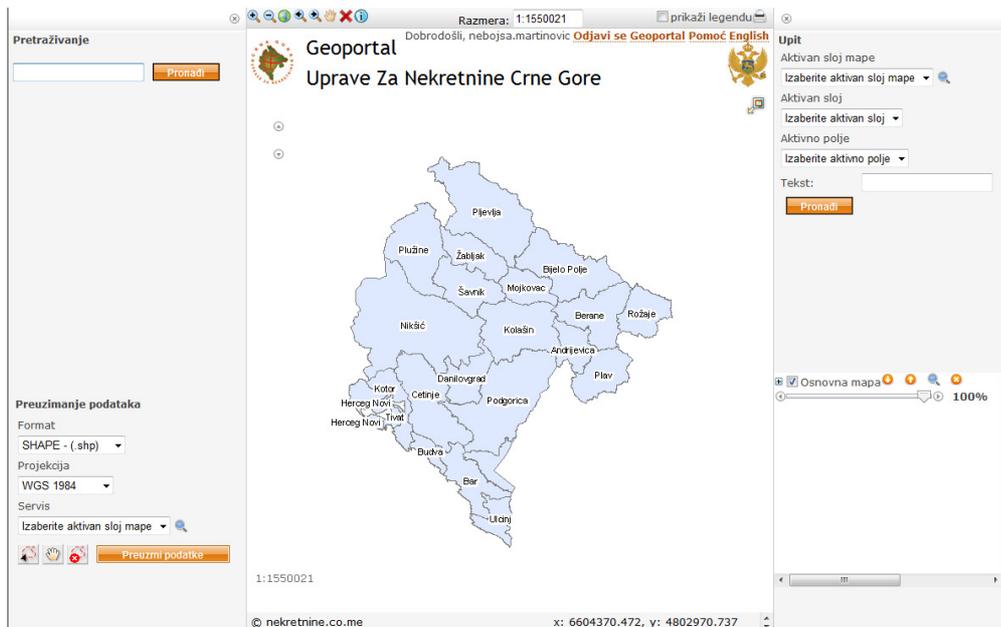


Figure 8 - Advanced metadata search

7. CONCLUSIONS

To be successful for a hosting organization, a geoportal requires clear executive sponsorship. Both the dedication of resources required at the outset for geoportal installation and the dedication of resources required for the ongoing vitality and growth of the geoportal will be highly dependent on such sponsorship. Likewise, the ready adoption and use of the geoportal by staff members to support their daily workflows and realize associated efficiencies will be greatly encouraged if management backing is understood.

To provide clear executive sponsorship, the host organization's management must first be convinced of the value of hosting a geoportal by reviewing the breadth of requirements and outcomes that it can expect. This paper provides a checklist of issues that have a bearing on the adoption and maintenance of a geoportal by an organization and is intended to provide a starting point for management.

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8. BIOGRAPHICAL NOTES OF THE AUTHORS



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