ESRI® Geoportal Technology

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ESRI Geoportal Technology

An ESRI White Paper

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Introduction

ESRI Provides Technology for Implementing Web-Based Geoportals

This white paper introduces ESRI's approach to the discovery and exchange of geospatial information resources on the Web and outlines the geoportal technology ESRI has developed in that context. The information presented below is intended to provide a basic overview and frame of reference for further technical inquiry and discussion.

The core vision and conceptual underpinnings that drive ESRI's geoportal technology are described in this document. That discussion is followed by a detailed description of ESRI's geoportal implementation software product—ArcGIS® Server Geoportal 9.3.1 extension—including elaboration of its functionality and structure. A review of geoportal implementation issues and recommendations concludes the document.

ESRI Geoportal Technology Has Evolved as a Key Element of Spatial Data Infrastructures

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.

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.

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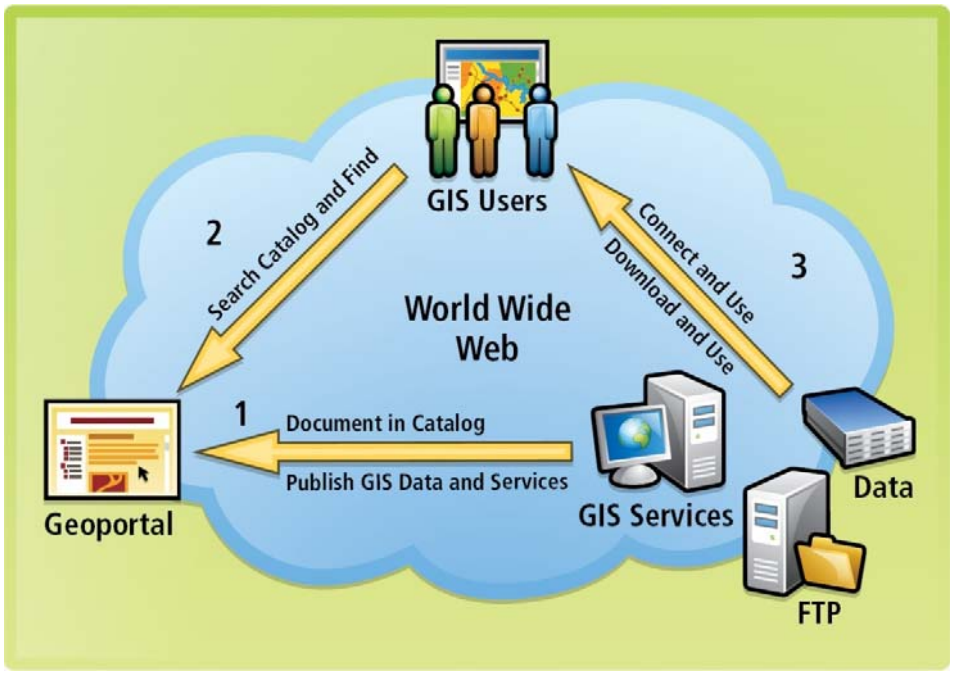
Conceptual Underpinnings

Vision: Discover and Exchange Geospatial Resources on the Internet

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.

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.

Approach: Provide Customizable Geoportal-Building Software

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.

Strategy: Package Core Geoportal Functionality

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. The structure and components of the ArcGIS Server Geoportal extension are described in more detail later in this document.

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, and a standard two-day ArcGIS Server Geoportal extension installation training course offered at ESRI or ESRI-authorized training facilities on a regularly scheduled basis.

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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.

- **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 geoportal administrator.

  Publishers on a geoportal that is built using the ArcGIS Server Geoportal 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 geoportal, create their metadata and post it using an online metadata entry form integrated into the geoportal, or make their metadata available on a Web server and register for external harvesting by the geoportal's metadata harvesting tool.

  The ArcGIS Server Geoportal 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 Geoportal extension also provides functionality that enables a geoportal 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 Geoportal extension functionality provides the option for integration with external LDAP authentication solutions to enable users to register. By design, ArcGIS Server Geoportal 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 geoportal to customize access to advanced functionality.

Functionality for Geoportal Management

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

- **Administrator—**A suite of ArcGIS Server Geoportal extension functionalities has been designed for the exclusive use of a geoportal administrator or manager. The administrator functionality enables the person or persons who manage a geoportal 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 Geoportal 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 Geoportal Data Security

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

At the data level, metadata publishers themselves have control over access to the information items that are cited in the metadata records they post. Publishers can determine how their data is made available (live viewing within portal, download from within the portal, link to publisher site for download, e-mail request to publisher, etc.) and are ultimately responsible for implementing restrictions on access at the source of the data.

Functionality for Geoportal Interoperability

A fundamental objective of the ArcGIS Server Geoportal 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 Geoportal 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 2 indicates the principal points of communication and the associated data communication standards, protocols, and formats that are supported.

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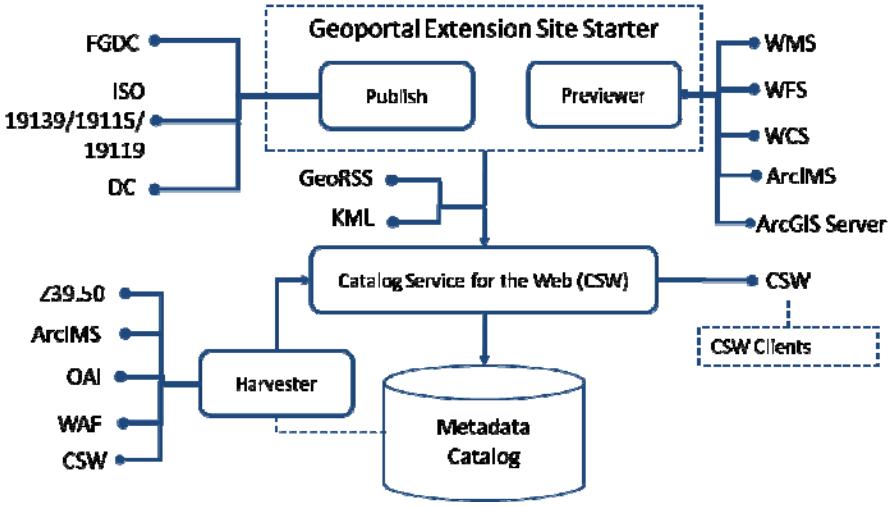
Figure 2
ArcGIS Server Geoportal 9.3.1 Extension Standards Support



Functionality for Interface Customization

The ArcGIS Server Geoportal 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 Geoportal extension components are easily configurable to fit together with supporting software and database elements within the host's unique architecture.

The anticipated customization and internationalization are achieved through a series of installation-specific file content value inputs and through resource file content that informs the basic ArcGIS Server Geoportal extension functionality with graphics and text.

ArcGIS Server Geoportal Extension Structure and Technical Requirements

Components

The ArcGIS Server Geoportal extension consists of seven principal structural components:

- Web components (components 1 and 2)

  - **Geoportal Web Application (Geoportal extension site starter)**
  - **Catalog Service**

  The **Geoportal Web Application** and **Catalog Service** components work seamlessly together via a single interface on the Web.

The Geoportal Web Application provides the interface tools and basic geoportal functionality (including the inline preview capability) needed to set up and operate a geoportal on the Web. The Catalog Service component provides the underlying database and data management capabilities that enable users to post and discover metadata records.

- Desktop components (components 3, 4, 5, 6, and 7)

  - Metadata Harvester

  The **Metadata Harvester** component is installed independently as an ArcGIS Server Geoportal extension desktop tool and can be configured to execute from a geoportal harvesting service.

  The Metadata Harvester enables a geoportal to proactively and automatically collect new and updated metadata records from preregistered data publishers for posting.

  - Catalog Service for the Web (CSW) Client for ArcMap
  - CSW Client for ArcGIS Explorer
  - Web Map Content (WMC) File Opener for ArcMap
  - Publishing Client for ArcCatalog

  The **CSW Client for ArcMap, CSW Client for ArcGIS Explorer, WMC File Opener for ArcMap, and Publishing Client for ArcCatalog** functionalities are components intended for desktop use.

  The basic function of the CSW Client for ArcMap is to enable users—from within their desktop ArcMap environment—to conduct Web metadata searches and view live services or metadata extents that they discover during the search. The basic function of the CSW Client for ArcGIS Explorer is to enable users—from within their desktop ArcGIS Explorer environment—to conduct Web metadata searches and undertake associated ArcGIS Explorer transactions. The WMC File Opener for ArcMap provides the ability to open externally generated WMC files for use within ArcMap, and the Publishing Client for ArcCatalog enables the publishing of metadata records to a geoportal based on the ArcGIS Server Geoportal extension from within ArcCatalog.

Infrastructure

To operate successfully, ArcGIS Server Geoportal extension components require selected underlying hardware and software:

- **Hardware—**Specifications for underlying hardware will necessarily be tied to the existing architecture of the hosting organization and the intended level of use. In general, however, common practice is that the Catalog Service and an associated host-specified Map Viewer component are installed along with ArcGIS Server on a single dedicated server with Internet connectivity, and the Catalog Service database is installed on a separate dedicated server with Internet connectivity.

  The Metadata Harvester requires installation on a desktop computer with Internet connectivity.

  The Geoportal desktop tools for ArcMap, ArcCatalog, and ArcGIS Explorer are installed separately.

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- **Software—**Required underlying software for the ArcGIS Server Geoportal 9.3.1 extension is listed below, to be configured with reference to the host-specific architecture.

  - **Operating System (one of the following)**
    - Red Hat® Enterprise Linux® AS/ES 5
    - Windows® XP SP2
    - Windows 2003 Server SP2
    - Windows 2008 Server Standard
    - Windows 2003 Server 64 bit

  - **ESRI Software**
    - ArcGIS Server 9.3.1 Advanced Enterprise or Standard Enterprise
    - ArcGIS Desktop 9.3.1 (optional but highly recommended)

  - **DBMS (one of the following with full text capabilities)**
    - Oracle9*i* (9.2.0.7)
    - Oracle® 10*g* (10.2.0.4)
    - Oracle 11*g* (11.1.0.7)
    - Microsoft® SQL Server® 2005 SP2
    - Microsoft SQL Server 2008
    - PostgreSQL 8.3

  - **Servlet Engine (one of the following)**
    - Apache Tomcat™ 5.5.17 or 5.5.27
    - Apache Tomcat 6.0.13
    - Oracle WebLogic 10 MP1 and 10.3
    - Sun™ GlassFish™ 2.1

  - **Java (one of the following)**
    - Java 1.5
    - Java 1.6

  - **Directory Server (recommended)**
    - LDAP-enabled Directory Server

Data Services

Installation of a geoportal based on the ArcGIS Server Geoportal 9.3.1 extension requires an ArcGIS Server Map Service (with a REST URL end point) and an ArcGIS Server Locator Service. A publicly available Locator Service can be found at http://sampleserver1.arcgisonline.com/ArcGIS/rest/services/Locators/ESRI_Geocode_USA/GeocodeServer.

Suggestions for Successful Geoportal Implementation

Clear Objectives

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.

Clear Understanding of Hosting and Management Requirements

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.

Commitment of Basic Resources

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.

More Information

For additional information on ESRI's ArcGIS Server Geoportal extension and associated implementation and technology transfer services, please contact

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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.

Our Focus

ESRI software is used by hundreds of thousands of organizations that apply GIS to solve problems and make our world a better place to live. We pay close attention to our users to ensure they have the best tools possible to accomplish their missions. A comprehensive suite of training options offered worldwide helps our users fully leverage their GIS applications.

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

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