ESRI® Geospatial Portal Technology

ESRI 380 New York St., Redlands, CA 92373-8100 USA
TEL 909-793-2853 • FAX 909-793-5953 • E-MAIL info@esri.com • WEB www.esri.com

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ESRI Geospatial Portal Technology

An ESRI White Paper

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Introduction

Purpose and Scope of This Document

This white paper introduces ESRI's approach to the discovery and exchange of geospatial information on the Web and outlines the geospatial portal 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 geospatial portal development efforts are described at the outset of this document. That discussion is followed by a detailed description of the principal ESRI® geospatial portal product—the GIS Portal Toolkit—including elaboration of its functionality and structure. A review of GIS Portal Toolkit implementation considerations concludes the document.

Context for Consideration of ESRI Geospatial Portal Technology

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

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 a real potential for improving decision making and operations at all levels of endeavor in service of a productive and sustainable future for everyone.

For this potential to be fully realized, geospatial information resources must be positioned both institutionally and technologically for wide discovery, exchange, and use.

The notion of spatial data infrastructure (SDI) has evolved as a conceptual framework for organizing institutions and technology to enable geospatial information sharing at a significant scale and is being explored today within and among organizations and governments at local, national, and global levels.

An SDI framework—whether conceived for narrow use at a local level or for broader use at a national or global level—is rooted in a requisite organizational or political will to support the sharing of spatial information. Information-sharing permissions, charters, agreements, standards, and architectures are required to confirm and formalize that will. Finally, technical mechanisms are required to enable participating parties to undertake the kind of exchange of information with one another that is intended.

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. It has developed its geospatial portal technology in particular to provide a technical mechanism—a geospatial information portal—for posting, discovering, and exchanging existing geospatial information resources in support

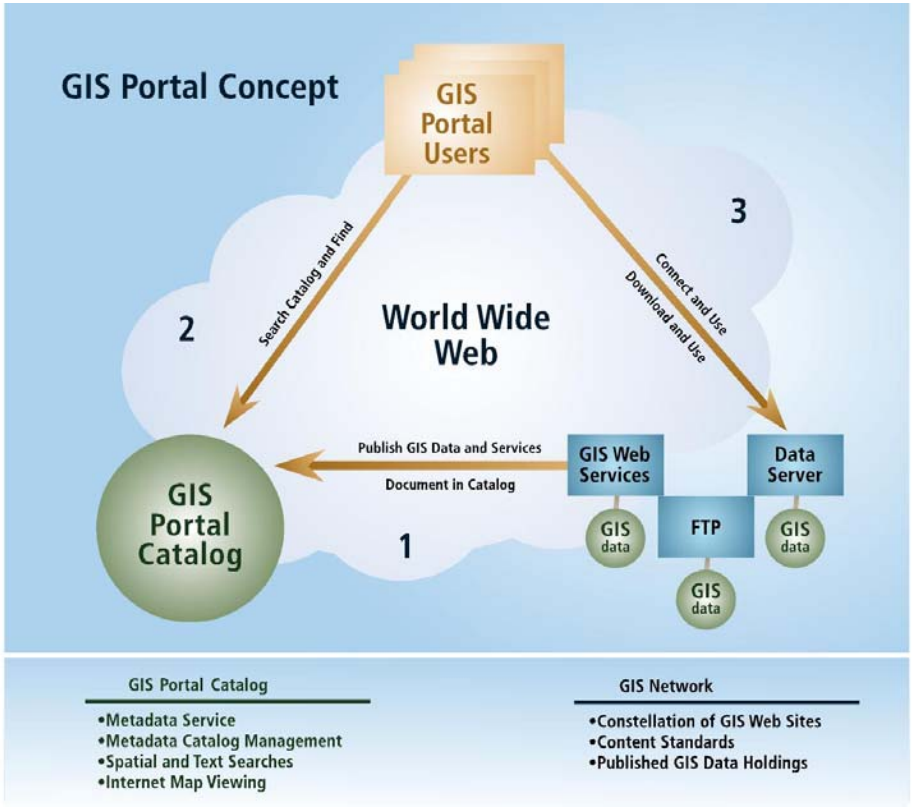
of both broadly based SDIs and more narrowly framed local and organization-specific data-sharing communities.

Conceptual Underpinnings

ESRI Vision: The Role of a Geospatial Information Portal

As envisioned by ESRI, the role of a geospatial information portal is to connect geospatial data producers and users by (1) enabling producers of geospatial information resources to create and post metadata records (citations describing their information resources) and (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. Further—and importantly—ESRI envisions that the role of such a portal is also (3) to provide the means for users to view geospatial information or otherwise access the 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 portal will consist of a wide range of information resource types. These will 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 using a variety of communication protocols. A geospatial portal's functionality therefore needs to anticipate and support that variety of technologies to the greatest practicable extent.

Overall, the ESRI vision is informed by the view that a portal is not only a mechanism for connecting parties and information; it is 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 portal itself, most mapping formats and projections should be viewable and graphically combinable.

ESRI Approach: Provide a Development Framework

ESRI's approach to supporting the widespread exchange of geospatial data resources is based on an understanding that every portal will be required to operate in unique circumstances and will be developed to address implementation-specific needs. ESRI also understands that despite the unique circumstances and needs of each portal implementation, there are basic functionalities that can support all portal implementations.

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

To support the ongoing synchronization of an ESRI-based geospatial information portal's technology with advances in GIS technology and Web-based communication technology and standards, ESRI's approach includes institution of a formal development track reflected by periodic new releases of ESRI's generic geospatial portal software.

ESRI Strategy: The GIS Portal Toolkit Technology and Services Package

The product ESRI has developed in the philosophical and technological context outlined above is packaged as a joint technology and services solution. The technology consists of a suite of Web-based and desktop software components collectively called the GIS Portal Toolkit. The services consist of an installation training and technology transfer program that supports the implementation of underlying architectures and an implementation-specific GIS Portal Toolkit configuration.

The GIS Portal Toolkit is a toolkit in the sense that it consists of a generic functionality base that by design anticipates implementation-specific configuration and modification of select files and tables to enable (1) conformance to the specific environment where it is being installed, (2) creation of a host-specific look and feel for the interface, and (3) activation of host-selected functionality options.

The GIS Portal Toolkit is currently delivered to clients when they enroll in and complete a three-day training course offered by ESRI or an ESRI Authorized Business Partner. The requisite training provides the background necessary for organizations to install and configure their own geospatial information portals using the GIS Portal Toolkit as a base.

Additional installation and customization services are available from ESRI to support these implementation efforts.

GIS Portal Toolkit Functionality

How the GIS Portal Toolkit Supports End Users

The components of the GIS Portal Toolkit work together and individually to provide a range of functionality that enables end users to

- **Discover GIS data resources produced by others—**The GIS Portal Toolkit implements functionality that enables users to discover and select information resources that are of particular interest to them. In addition to traditional term-based searches, the toolkit functionality enables users to (1) find information items within a topic of interest by selecting a focused interest "channel" that preconsolidates information resources or (2) find information items within a geographic area the user draws on a map or that pertain to a user-defined place-name or address.

  The results of any GIS Portal Toolkit 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 GIS Portal Toolkit includes functionality that enables the user to (1) link directly to the Web site that hosts the cited information item if that option is made available by the information item publisher or (2) as described below, view the information item if it is a "live" map available from a service maintained by the information item publisher.

- **View geospatial data resources produced by others—**The GIS Portal Toolkit provides functionality that automatically retrieves and displays mapped data maintained on Web-accessible map services if metadata about that mapped data has been published on the portal and if the target map service is maintained by the data publisher. When a user elects to view mapped data described by a search result (summarized metadata), a GIS Portal Toolkit Map Viewer window automatically pops up and the requested data is loaded atop a default basemap.

  The information the toolkit requires to make this happen is included in validated and published metadata records if the cited information item consists of what the toolkit recognizes as 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.

  The opportunity to view live data or maps or link directly to a publisher's Web site to view an information item is provided in association with each search result.

- **Make maps combining GIS data produced by others—**A GIS Portal Toolkit Map Viewer enables users to combine mapped data from different live map sources, conform them to a single map projection and extent, and overlay them on a single basemap. This can be done by combining map services selected from a drop-down list of Web-accessible map services available through the GIS Portal Toolkit Map Viewer interface and/or by selecting live maps that have been discovered during a metadata search.
  Map layers included in a live map that is added to a Map Viewer map are listed in the Map Viewer legend, and the user can select which layers to include or omit on the map display.

  Once a map is completed, the GIS Portal Toolkit functionality provides a save map function that enables users to save the map they have created for use in subsequent Map Viewer sessions. The toolkit functionality also enables users to save the map to their own computer or network as an Open Geospatial Consortium (OGC®) Web Map Context file.

- **Obtain data resources from data services maintained by others—**Any information item that is cited in metadata published on a portal based on the GIS Portal Toolkit is obtainable if the publisher of the information item makes it available. Live map images or composite map images created with GIS Portal Toolkit Map Viewer functionality can be downloaded to a user's system after the map is saved. Other information items, including any data associated with a map image, can be obtained (if made available by the publisher) by using the option to link to the publisher's Web site.

- **Expose one's own GIS data resources for discovery by others—**GIS Portal Toolkit functionality enables any Web-based geospatial information producer authorized by an administrator of a portal based on the GIS Portal Toolkit to publish metadata describing the information on that portal. Unless a GIS Portal Toolkit portal administrator determines otherwise as a policy matter, publishers create their own metadata and make their own determinations about how and to whom the information described in their metadata is made available.

  As administrator-approved publishers on a particular portal based on the GIS Portal Toolkit, data producers have three basic options for posting their metadata. They can (1) create their metadata using ArcCatalog™ or an independent XML editor and upload the records to the target portal based on the GIS Portal Toolkit, (2) create their metadata and post it using a GIS Portal Toolkit online metadata entry form, or (3) make their metadata available on a Web server and register for external harvesting by the administrator of a portal based on the GIS Portal Toolkit using a GIS Portal Toolkit metadata harvesting tool.

  The GIS Portal Toolkit includes functionality that can be engaged to automatically validate submitted metadata records against applicable metadata standards (Federal Geographic Data Committee [FGDC], ISO 19115, ISO 19139). Publishers are informed of metadata records that fail this automatic validation. The GIS Portal Toolkit also provides functionality that enables an administrator of a portal based on the GIS Portal Toolkit to review and approve all technically validated metadata records before final posting to the portal.

- **Register as a portal user—**GIS Portal Toolkit functionality provides the option for users to register. By design, the basic toolkit functionality does not require user registration for basic search and search results viewing. The option to register, however, is provided to enable the managers of a portal based on the GIS Portal Toolkit to customize access to advanced functionality and selected data based on user name and ID.

How the GIS Portal Toolkit Supports Portal Management

Three principal management roles are anticipated by GIS Portal Toolkit functionality:

- **Administrator—**A suite of GIS Portal Toolkit functionality has been designed for the exclusive use of an administrator or manager of a portal based on the GIS Portal Toolkit. The administrator functionality enables the person or persons who manage a portal to exercise control over all metadata publication, data security, user registration, special interest channel creation and management, portal use tracking, and other 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-specific GIS Portal Toolkit functionality is restricted to users who are designated as publishers by a portal administrator. Publisher functionality enables publishers to post and manage their metadata records using special toolkit functions available only to them. Publishers are required to be registered users, and publisher function options are provided on their home page upon login based on the publisher's user ID and password.

- **Channel Steward—**GIS Portal Toolkit functionality that is specific to the management of special interest channels of information is restricted to use by channel stewards who are designated by a portal administrator. Channel steward functionality enables channel stewards to develop and manage content within a specific channel that is created for them by the portal administrator. Channel stewards are required to be registered users, and channel steward function options are provided on their home page upon login based on the channel steward's user ID and password.

How the GIS Portal Toolkit Supports Data Security

Metadata publishers 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 and are ultimately responsible for implementing restrictions on access at the source of the data. In addition, publishers can designate that their metadata only be exposed to logged in registered members of a specific group of users that is predesignated and password protected by the administrator upon publisher request.

How the GIS Portal Toolkit Supports Interoperability

A fundamental objective of the GIS Portal Toolkit 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, GIS Portal Toolkit 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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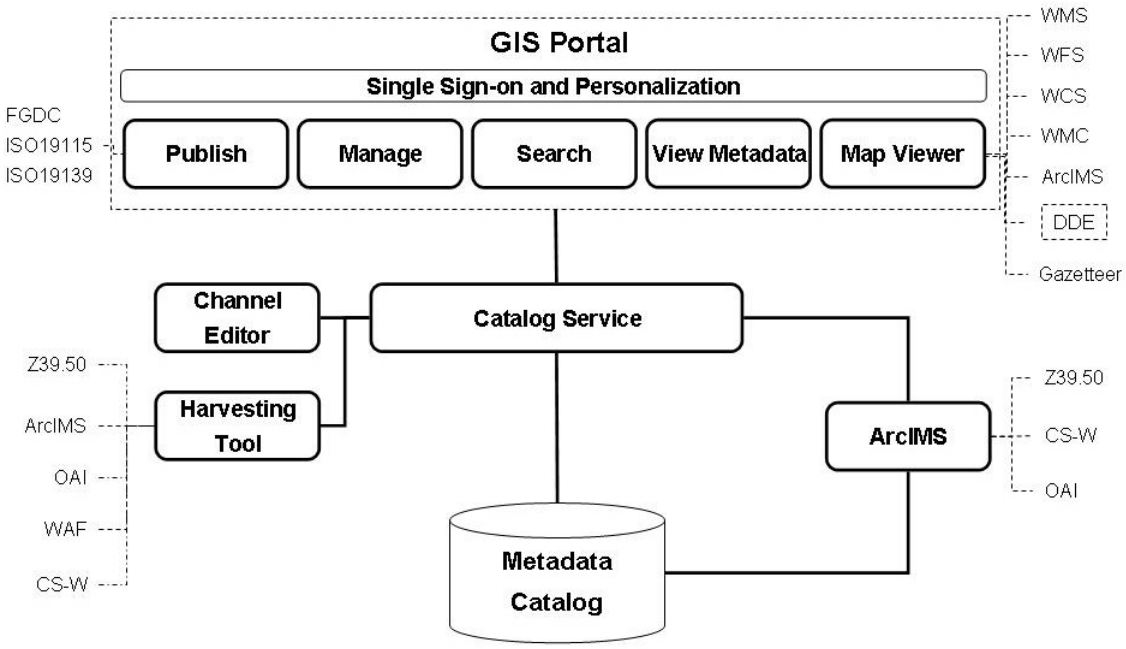
Figure 2
GIS Portal and Standards Support



How the GIS Portal Toolkit Supports Interest Groups

Special interest user groups can be supported through the creation of special interest channels using GIS Portal Toolkit functionality. Such channels are generally topic, event, or issue based. In each case, the channel is accessed by clicking a channel name on the portal home page. A channel consists of preselected metadata records and external links that are compiled by a designated channel steward.

How the GIS Portal Toolkit Supports Customization

The GIS Portal Toolkit anticipates customization of the user interface elements (including both graphics and text) and implementation-specific configuration to default basemap, default geocoding, and other services. In addition, the toolkit components are easily configurable to fit together with supporting software and database elements within the host's unique architecture.

The anticipated customization is achieved through a series of installation-specific file content value inputs and through resource file content that informs the basic toolkit functionality with graphics and text.

How the GIS Portal Toolkit Supports Internationalization

Internationalization consists of modification of interface text to reflect languages (and associated writing systems if applicable) that are desired by the portal host. The resource file approach and structure implemented beginning with GIS Portal Toolkit 3.1 were designed to facilitate replacement of the default English language with other languages.

The language options that come packaged with the toolkit are as follows:

- Chinese
- Dutch
- French

- German
- Spanish

Internationalization to reflect any additional languages can be accomplished by translating the English text in the interface resource files and replacing the content directly.

How the GIS Portal Toolkit Supports Spatial Data Infrastructures

GIS Portal Toolkit functionality is designed to support the posting and discoverability of geospatial information on the Web. The toolkit mechanism, along with the distributed data creation, maintenance, use, and communication systems that support it, represents—at whatever level implemented—the technical foundation for an SDI. To be employed effectively in the SDI context, the institutional underpinnings that promote the creation and use of geospatial information and the willingness to share the geospatial information must be in place as well.

GIS Portal Toolkit Structure and Technical Requirements

Overview of GIS Portal Toolkit Components

The toolkit consists of six principal structural components:

- Web components (components 1 and 2)
  - Catalog Services
  - Map Viewer

  The **Catalog Services** and **Map Viewer** components work seamlessly together via a single interface on the Web.

  The basic function of the Catalog Services component is to enable users to post and discover metadata records. The basic function of the Map Viewer component is to enable users to view mapped data that has been discovered and create new maps that overlay discovered data.

- Desktop components (components 3 and 4)
  - Channel Editor
  - Metadata Harvester

  The **Channel Editor** and **Metadata Harvester** components are installed independently as GIS Portal Toolkit desktop tools.

  The basic function of the Channel Editor is to enable the compilation of metadata and other information resources that address a special community interest (a special interest channel) so that users with that interest can go directly to the preselected body of resources from the portal home page. The basic function of the Metadata Harvester is to enable a geospatial portal to proactively and automatically collect new and updated metadata records from preregistered data publishers for posting on the portal.

- Desktop software extension components (components 5 and 6)
  - Portal Toolbar for ArcMap™
  - ArcGIS® Explorer Catalog Search Task

  Both the **Portal Toolbar for ArcMap** and the **ArcGIS Explorer Catalog Search Task** functionalities are delivered as software extension components that can be downloaded from a GIS Portal Toolkit home page for installation in a user's own ArcMap or ArcGIS Explorer environment.

  The basic function of the Portal Toolbar for ArcMap is to enable users—from within their *ArcMap* environment—to conduct Web metadata searches and capture maps from live services that they discover during the search. The basic function of the ArcGIS Explorer Catalog Search Task is to enable users—from within their *ArcGIS Explorer* environment—to conduct Web metadata searches and undertake associated ArcGIS Explorer transactions.

Underlying Infrastructure Requirements

To operate successfully, GIS Portal Toolkit 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 Services and Map Viewer components are installed on a single dedicated server with Internet connectivity and the Catalog Services database is installed on a separate dedicated server with Internet connectivity.

  Channel Editor and Metadata Harvester will require installation on a desktop computer with Internet connectivity.

  The Portal Toolbar for ArcMap and ArcGIS Explorer Catalog Search Task links are embedded in the Catalog Services component and require no independent installation.

- **Software—**Required underlying software is listed below, to be configured with reference to the host-specific architecture.

OS	Windows® 2000, Windows XP, Windows Server 2003, and Red Hat® Linux® 9 (Enterprise 3.0)
Database	Oracle9*i*, Oracle® 10*g*, SQL Server™ 2000, SQL Server 2005, DB2® 8.2
ArcSDE®	9.1 SP2 or 9.2 SP2
Web server	IIS5, IIS6, and Apache 2.0.48
Java™ SDK	J2SDK1.4.2_06 or J2SDK1.5.0_06
Tomcat™	5.0.28 or 5.5.17
ArcIMS®	9.1 SP2 or 9.2 SP2
ArcGIS	9.1 SP2 or 9.2 SP2

Underlying Data Service Requirements

Installation of a portal based on the GIS Portal Toolkit requires configuration of several ArcIMS services. Specification of services depends on a portal host's intentions and needs. Services can be configured that provide, for example, a portal-specific Advanced

Search basemap (for designating area of interest for each search), a portal-specific Map Viewer basemap (for overlaying and viewing live mapped data discovered and selected by the user), a Map Viewer Acetate Map, or a gazetteer to support the portal's search capabilities. Such services are available on the Web or can be developed by the portal host.

Considerations for GIS Portal Toolkit Implementation

About Objectives

Clear objectives that are based on anticipated business processes and an anticipated user population are essential to a successful GIS Portal Toolkit implementation and are most effective when developed at a high level and independently of the question "What can the GIS Portal Toolkit do?" When objectives are clear, the capabilities of the GIS Portal Toolkit can be understood in context, and it will be evident whether the toolkit can help provide the solution that is sought.

About Hosting Requirements

Fundamental to a successful GIS Portal Toolkit deployment is a clear understanding of 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 toolkit-based portal 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 toolkit-based portal by an organization.

Prerequisites for Successful Implementation

A geospatial information portal implementation based on the GIS Portal Toolkit is accomplished atop a variety of essential building blocks that provide the underpinning for the successful installation, configuration, and operation of the software. A toolkit-based portal can only succeed when these elements are in place.

- **Organizational sponsorship** is required to initiate consideration of a portal based on the GIS Portal Toolkit and support development of a plan for implementation.
- **People** must be in place and trained appropriately to manage and "grow" the portal. Without the appropriate human support, GIS Portal Toolkit functionality and data will serve no purpose.
- **Data** is required to support GIS Portal Toolkit functions and must be prepared and available in a form and technical circumstance that "feeds" the portal seamlessly. Without data, the toolkit functionality will serve no purpose.
- **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 GIS Portal Toolkit.

For More Information

For additional information on the ESRI GIS Portal Toolkit and associated implementation and technology transfer services, please contact

ESRI Professional Services
380 New York Street
Redlands, California 92373
Attn.: Portal Toolkit Team
E-mail: portal@esri.com

ESRI
380 New York Street
Redlands, California
92373-8100 USA

Phone: 909-793-2853
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For more than 35 years, ESRI has been helping people make better decisions through management and analysis of geographic information. A full-service GIS company, ESRI offers a framework for implementing GIS technology and business logic in any organization from personal GIS on the desktop to enterprise-wide GIS servers (including the Web) and mobile devices. ESRI GIS solutions are flexible and can be customized to meet the needs of our users.

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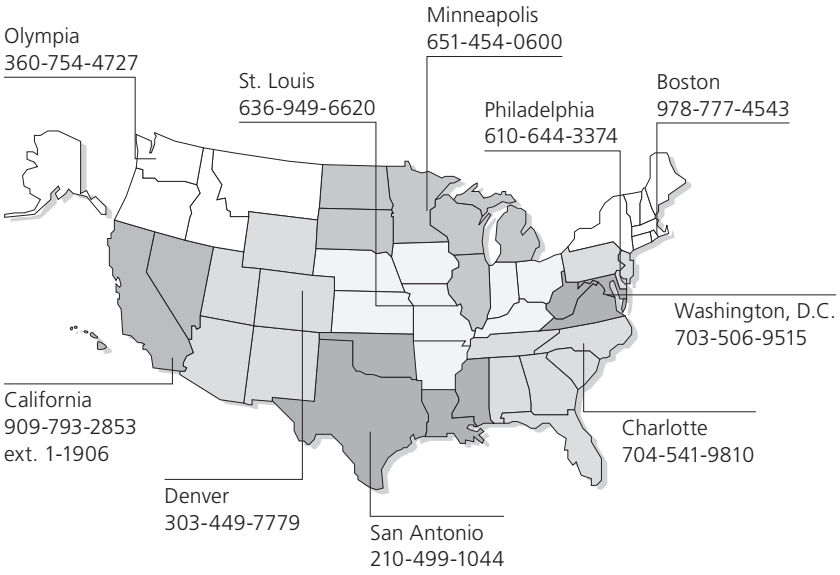

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