



Metadata and GIS

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Contents	Page
GIS Data Sharing on the Internet Is a Reality	1
ESRI Supports Metadata	1
Why Is Metadata Important to GIS?	1
Metadata and GIS Management.....	2
ESRI Supports Metadata Management	2
Access to Metadata.....	2
What Is Metadata?.....	2
Metadata Standards	3
Digital Communication Standards	3
Using Z39.50 to Participate in the NSDI Clearinghouse	3
How Does ESRI Support Metadata?	3
Authoring Metadata.....	4
Standards-Based Metadata Tools	5
Supported Data Types	5
Authoring Custom Metadata	5
Publishing Metadata	5
ArcSDE	6
Clearinghouse Support	6
Discovering Metadata	7
With ArcCatalog	7
With Metadata Explorer	7
With Clearinghouse (Z39.50) Clients	8

Metadata and GIS

"ESRI feels that software for creating, editing, and managing metadata should be a standard feature built into any GIS system—not something 'extra.'"

—Jack Dangermond, ESRI President

GIS Data Sharing on the Internet Is a Reality

This is an exciting time to work with metadata because an Internet infrastructure for global data access is fully functional. Several organizations have developed metadata systems. One of the most evolved and well-supported is the Federal Geographic Data Committee (FGDC) National Geospatial Data Clearinghouse, also known as the National Spatial Data Infrastructure (NSDI). The NSDI Clearinghouse is realized as a group of "gateways" that send out search requests to participating servers on the Internet. Because the NSDI Clearinghouse is based on protocols for data exchange established by the Library of Congress, it can provide access to geographic information system (GIS) data for users who are not necessarily GIS users. At this writing, more than 200 GIS metadata services are participating in the NSDI Clearinghouse.

ESRI Supports Metadata

ESRI® technology supports metadata creation and editing as a standard part of ArcGIS™ Desktop. ESRI is committed to supporting metadata standards such as those from the FGDC and International Organization for Standardization (ISO). Support for these standards is included with ESRI GIS software. ESRI software can be customized to support other standards.

Metadata services are a standard part of ArcIMS®, the ESRI GIS Web server. ArcIMS offers full support to the NSDI Clearinghouse. Any ArcIMS user can immediately participate in the NSDI Clearinghouse using ESRI software.

ESRI supports the NSDI Clearinghouse by providing a [clearinghouse gateway](#) node.

Why Is Metadata Important to GIS?

ESRI is realizing a vision of global data sharing by creating technology to support metadata. Metadata makes spatial information more useful to all types of users by making it easier to document and locate data sets. The growing availability of data of all kinds from many different sources has helped GIS technology become more useful and widely adopted. With metadata support, data producers can publish information about data, and data consumers can search for the data they need.

Because spatial data is the fuel of a GIS, it is important to know if the data will meet user needs. Data users need metadata to locate appropriate data sets. Metadata provides information about the data available within an organization or from catalog services, clearinghouses, or other external sources. Metadata not only helps find data, but once data has been found, it also tells how to interpret and use data. Publishing metadata facilitates data sharing. Sharing data between organizations stimulates cooperation and a coordinated, integrated approach to spatially related policy issues.

Metadata and GIS Management

Keeping spatial metadata records is important. From a data management perspective, metadata is important for maintaining an organization's investment in spatial data. Metadata benefits an organization in the following ways:

- Provides an inventory of data assets
- Helps determine and maintain the value of data
- Helps you determine the reliability and currency of data
- Supports decision making
- Documents legal issues
- Helps keep data accurate and helps verify accuracy to support good decision making and cost savings
- Helps determine budgets because it provides a clearer understanding of when or if data needs to be updated or repurchased

Both data and time are costly. A GIS development plan that takes metadata into account from the beginning will save time and money later. Data expense continues to be the largest part of most GIS budgets, usually more than staff costs. If metadata is part of standard operating procedures, creating metadata costs virtually nothing. Time and effort related to metadata should be entered into the budget or project plan of every GIS operation.

For example, because GIS technology can provide detailed, visual data presentations, it is an indispensable resource for emergency response. Officials facing homeland security issues understand they need *rapid* access to many kinds of data to respond quickly and effectively. Metadata is the key to providing *timely* information that can be easily accessed and shared across multi-jurisdictional boundaries at all levels of government. In emergencies, officials also need to share accurate, up-to-date information with the media and the public.

ESRI Supports Metadata Management

Metadata should be a standard part of any GIS and not an extension of functionality. Metadata is a fundamental component of every user's GIS implementation. The tools for creating and managing metadata are key technologies for sharing geographic information and building communities. ESRI includes these tools in our core software products.

Access to Metadata

GIS managers must control access to GIS data and metadata. ESRI software provides appropriate access to metadata on the server. Different people can have different levels of access: browsing, publishing, and administrating.

What Is Metadata?

Metadata is a summary document providing content, quality, type, creation, and spatial information about a data set. It can be stored in any format such as a text file, Extensible Markup Language (XML), or database record. Because of its small size compared to the data it describes, metadata is more easily shareable. By creating metadata and sharing it with others, information about existing data becomes readily available to anyone seeking it. Metadata makes data discovery easier and reduces data duplication. ESRI stores metadata with the data set it details and may additionally index metadata in a central database for sharing. ESRI software uses the XML standard for metadata processing.

GIS metadata has a spatial component such as the extent of the earth's surface the data covers. Metadata can describe GIS data, a GIS Web service, or an online metadata catalog. Metadata can also describe nonelectronic data such as paper maps or offline electronic data such as data stored on CD or tape media. Open standards for metadata enable the data clearinghouse concept, also known as a catalog service. Two well-known GIS metadata catalog services are the Geography NetworkSM and the NSDI Clearinghouse.

Metadata Standards

Official standards organizations define metadata standards. By adhering to common metadata standards, organizations are more able to share data. An important standard in the United States is the FGDC Content Standard for Digital Geospatial Metadata, first published in 1998. The International Organization for Standardization has also created a spatial metadata standard.

For both the FGDC and ISO standards, ESRI provides a set of tools.

- A metadata editor
- Style sheets that present the metadata in various report formats
- A synchronizer that automatically records a data set's properties in the appropriate metadata elements for that standard

ESRI is committed to supporting open metadata standards with appropriate technology.

Digital Communication Standards

ESRI software creates metadata in XML format. XML is a metamarkup language, but unlike HTML, it describes structured data content rather than display properties. XML is an open industry standard that is platform neutral and oriented to publishing and distributing information using the Internet. Any metadata published in valid XML will be accepted by any metadata service.

Z39.50 is an open, well-established communications protocol for information sharing on wide area networks. Clients and servers can send and receive requests and responses using the Z39.50 protocol. The FGDC uses Z39.50 to implement the NSDI Clearinghouse, which enables searches for spatial data over the Internet.

Using Z39.50 to Participate in the NSDI Clearinghouse

ArcIMS 4.0.1 provides the Z39.50 Connector, which translates requests and responses between Z39.50 and internal ESRI protocols. The key point of the ArcIMS Z39.50 Connector is that metadata services can immediately become a node on the NSDI Clearinghouse network at no extra cost and out of the box.

How Does ESRI Support Metadata?

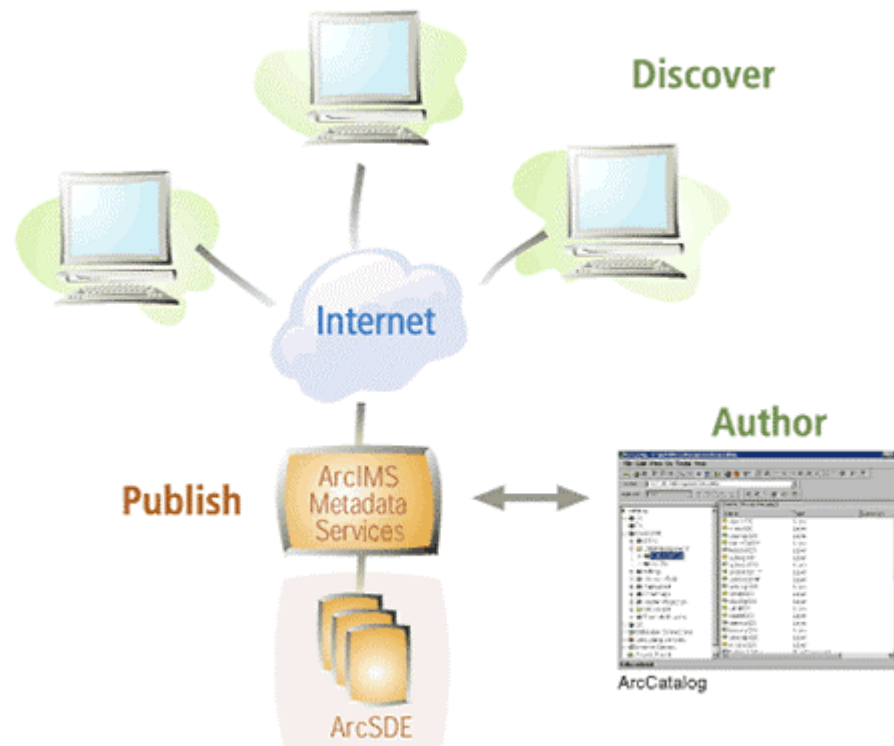
ESRI's metadata services let users create customized and centralized online repositories of metadata at any level—Intranet or Internet.

Metadata services are built on the functionality of three existing ESRI products.

- The ArcGIS ArcCatalogTM application is used for creating and authoring metadata and sending to a metadata service.
- ArcIMS and ArcSDETM—ArcIMS hosts the metadata service; ArcSDE is the interface to the relational database that stores metadata documents.

- ArcCatalog, Metadata Explorer, Web browsers, or Z39.50 clients can access metadata stored in a metadata service.

For more information on ESRI metadata support, download the ESRI white paper [*ArcIMS 4 Architecture and Functionality*](#).



Authoring Metadata

ArcCatalog, an application included with ArcGIS, automatically captures some core metadata and updates metadata automatically when possible. For example, spatial extent and coordinate system can be automatically supplied. ArcCatalog automatically attaches metadata to the data set to ensure integrity. ArcCatalog will fill in as much information as it can using the data's properties. When the data changes—for example, when a new attribute has been added—the next time you look at the metadata, ArcCatalog automatically updates it with the new information.

ArcCatalog can send data to the ArcIMS metadata service, which requires at least the following metadata items:

- Title
- Publisher
- Spatial extent
- Data theme
- Content type

Standards-Based Metadata Tools

ArcCatalog comes with metadata editors that you can use to document your data. Two editors are available in ArcCatalog for metadata creation. One follows the FGDC standard and the other follows the ISO standard. For each standard, ArcCatalog provides these components:

- Synchronizer (for automatic information capture)
- ActiveX control (editor)
- Document type definition (optional—for validation)
- Style sheets (for viewing)

Metadata created in ArcCatalog is stored in XML format.

Supported Data Types

ArcGIS 8 has been designed to create metadata for any data set supported/created by ArcGIS as well as any other data set identified and cataloged by the user (e.g., text, CAD files, scripts). Supported data sets include the following:

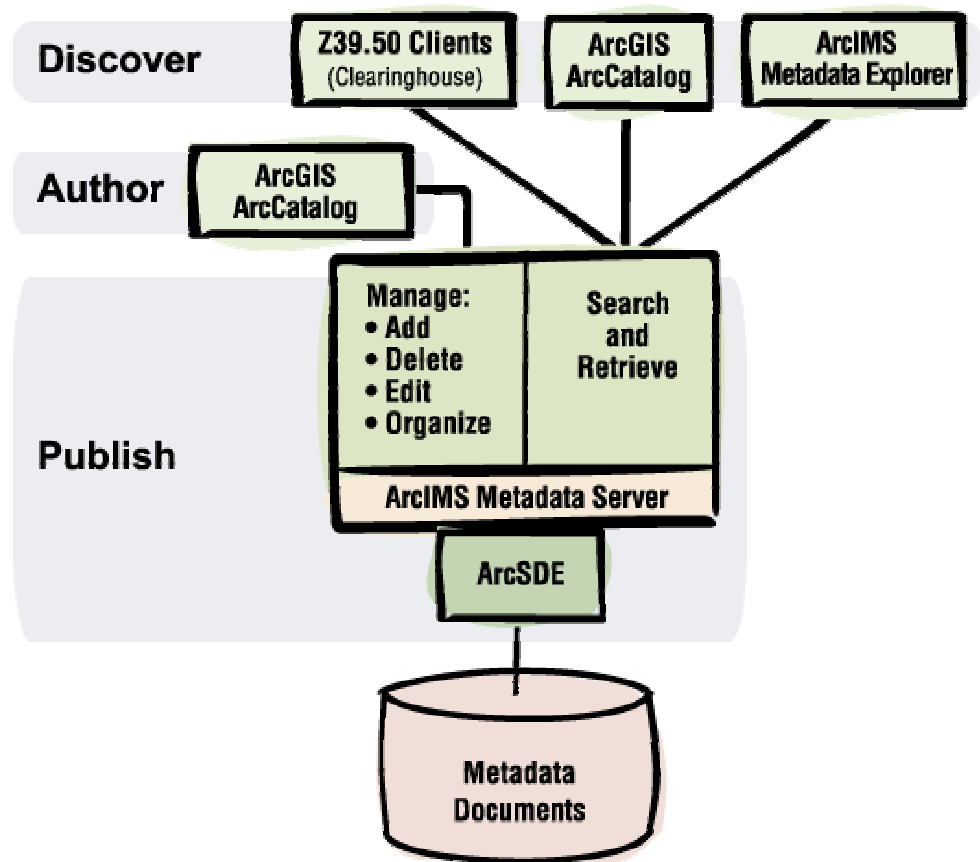
- ArcInfo™ coverages
- ESRI shapefiles
- CAD drawings
- Images
- GRIDs
- TINs
- PC ARC/INFO® coverages
- ArcSDE geodatabases
- Personal ArcSDE
- Workspaces
- Folders
- Maps
- Layers
- INFO™ tables
- dBASE® tables
- DBMS tables
- Projections
- Text files
- Programming scripts

Authoring Custom Metadata

The ArcCatalog ISO metadata editor can be customized. Users can create their own metadata editor components. ESRI metadata tools can be extended to support other metadata standards, such as the Dutch version of the European CEN/TC287 metadata standard, as described in the *ArcUser* article, "[Implementing European Metadata Using ArcCatalog](#)," online at the ESRI Web site. Examples are available on ArcObjects Online at www.esri.com/arcobjectsonline.

Publishing Metadata

The metadata service is included with ArcIMS, so all users of ArcIMS receive this component as part of the core software. The ArcIMS metadata service makes metadata created with ArcCatalog available on the Internet.



ArcSDE The ArcIMS metadata service uses an ArcSDE database as the repository into which all published metadata documents are stored. By using ArcSDE, metadata searches can use ArcSDE software's spatial indexing capability. ArcIMS relies on ArcSDE to store, search for, and retrieve metadata documents. All requests from ArcIMS are translated to Structured Query Language (SQL) and sent through ArcSDE to the relational database. The response follows the same path in reverse from the database to the ArcIMS service. Database connection information, such as the ArcSDE server, database, user name, and password, is specified in the metadata service configuration file. Several parameters are also available to tune the ArcSDE database to specific needs.

In addition to the layer and the tables that are automatically created by ArcIMS for a metadata service, ArcSDE can be further customized to give the database additional functionality when receiving requests and sending back responses. The default database consists of a set of tables used to store the published documents and associated information.

Clearinghouse Support

In the simplest case, a metadata service provides only the information copied to that service. To expand the amount of metadata that metadata service can return to a query, ArcIMS provides a mechanism to integrate with other metadata publishers. ArcIMS Metadata Explorer can initiate a distributed search by passing a search request for metadata onto NSDI Clearinghouse metadata services, which performs the actual distributed search. Another approach is to actually copy metadata from other services;

this approach is called harvesting. Harvesting means importing the contents of another metadata service into your metadata service. You can also export the contents of your metadata service for others to harvest. Organizations that want to implement clearinghouse functionality can do so with ArcIMS harvesting.

Discovering Metadata

With ArcCatalog

You can use ArcCatalog to search for data. If you know something about the data you are looking for but do not know where it is located, ArcCatalog can help. The Search tool will look on disks, in databases, and on ArcIMS metadata services for data that satisfies your criteria. You can search for specific data formats and for maps covering a defined geographic area. For example, you might try to find rasters that were published before a given date and that have less than 10 percent cloud cover. As ArcCatalog finds data that satisfies your search criteria, shortcuts to those sources are added to the search results list. ArcCatalog saves your search so you can run it again later.

With Metadata Explorer

Metadata Explorer is a Web-based JavaServer Pages (JSP) application included with ArcIMS. Metadata Explorer is a server-side application that can be customized as necessary. You provide Metadata Explorer to visitors to your Web site for their use in searching your data. Metadata Explorer is a fast, lightweight, easy-to-use application that conforms to the security policy in force at your site. The Metadata Explorer runs in both Netscape and Internet Explorer versions 4.0 and above. Metadata Explorer can search in two ways: by specifying detailed search criteria (spatial or textual or both) or by browsing through the server's contents.

A search via ESRI's Metadata Explorer offers the option to search the NSDI Clearinghouse. Note the check box on the bottom of the Metadata Explorer search interface that says "Search NSDI Clearinghouse." Checking this option will pass your search criteria on to NSDI Clearinghouse servers, thus expanding your search from a single metadata service to all the servers in the clearinghouse.

The screenshot displays the 'Search' tab of a web application. At the top, there are two tabs: 'Search' (active) and 'Browse'. Below the tabs, the interface is divided into three numbered sections:

- 1 DEFINE SEARCH AREA**: This section includes a checkbox labeled 'Find Place for Search' which is unchecked. Below it is a text input field containing the word 'World' and a yellow 'GO!' button. Underneath the input field is a row of six icons: a red square, a crosshair, a magnifying glass with a plus sign, a magnifying glass with a minus sign, a hand cursor, and a globe. Below these icons is a world map with the word 'World' written in red across the center.
- 2 DEFINE SEARCH CRITERIA**: This section contains three dropdown menus. The first is labeled 'Type of Content' and has 'All Geographic Content' selected. The second is labeled 'Data Theme' and has 'All Data Themes' selected. The third is a text input field labeled 'Keyword (e.g., river)' which is currently empty.
- 3 SEARCH**: This section features a yellow 'SEARCH' button and a checkbox labeled 'Search NSDI Clearinghouse' which is unchecked.

For online examples of Internet implementations of metadata using ArcIMS and Metadata Explorer, visit the [Geography Network](#), [the Delaware Data Mapping and Integration Laboratory](#), and [Kentucky's Geographic Network](#).

With Clearinghouse (Z39.50) Clients

There are many Z39.50 search clients; Z39.50 client software has been used for years in libraries. This fact lets the geography department at a university, for example, plug its spatial data (via an ArcIMS metadata service) into the general library search interface. A "clearinghouse client" can be a Web browser used for searching from one of the clearinghouse gateway sites.

The check box at the bottom of the Metadata Explorer opens a custom Web page that searches the clearinghouse via the ESRI gateway. Thus, Metadata Explorer is also a clearinghouse client.

People using a Web browser can directly access Metadata Explorer at an ArcIMS site because the site directs them to it. Other people will use a browser to search an ArcIMS metadata service via the clearinghouse gateway. You can use a browser with a custom Z39.50 client, which is not part of the clearinghouse. Still other people will use nonbrowser Z39.50 clients such as those that have been used in libraries for years.

By adhering to open standards such as XML, FGDC and ISO metadata, and Z39.50, ESRI provides a robust metadata solution that is available at no extra cost and fully compatible with the metadata efforts of the GIS community as a whole. Metadata builds communities.



For more than 30 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS technology in any organization with a seamless link from personal GIS on the desktop to enterprisewide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users. ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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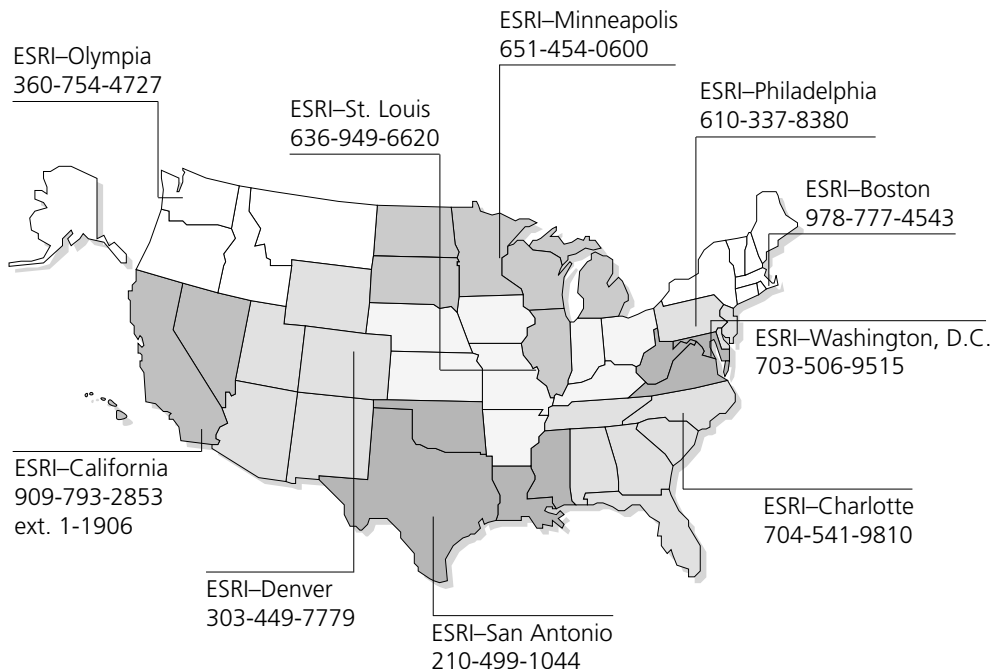
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