

# NSDI Standards in Software Acquisitions

## Background

There are three things you should know if you are involved in U.S. Government acquisition of products or services that may deal with "locational data", meaning any data or information that can be referenced to a place on the Earth. [1]

First, you should know that such data and information qualifies as "geographic information" (also known as "spatial data") under the E-Government Act. [2] (see Federal Law, right)

Second, you should know that U.S. Federal policy concerning geographic information and associated systems is focused on developing and promoting the U.S. National Spatial Data Infrastructure (NSDI). The purpose of the NSDI is to encourage the collection, processing, archiving, integration, and sharing of geospatial data and information using common standards and interoperable systems and techniques. Federal policy concerning the NSDI is given in OMB Circular A-16. [3] (see Federal Policy, right)

Circular A-16 further requires that agencies "Before the obligation of funds, ensure that all expenditures for spatial data and related systems activities financed directly or indirectly, in whole or in part, by federal funds are compliant with the standards and provisions of the FGDC." Circular A-16 also states: "All Information Technology systems which process spatial data should

**Federal Law** - The E-Government Act, Section 216 ("Common Protocols for Geographic Information Systems") assigns responsibility to the Federal Geographic Data Committee (FGDC) for "the development of common protocols for the development, acquisition, maintenance, distribution, and application of geographic information [...]" The common protocols shall be designed to:

- (1) maximize the degree to which unclassified geographic information from various sources can be made electronically compatible and accessible; and
- (2) promote the development of interoperable geographic information systems technologies".

**Federal Policy** - OMB Circular A-16 (as revised in 2002) "establishes a coordinated approach to electronically develop the National Spatial Data Infrastructure". Circular A-16 "provides direction for federal agencies that produce, maintain or use spatial data either directly or indirectly" and directs such agencies, "both internally and through their activities involving partners, grants, and contracts" to:

- (1) Prepare, maintain, publish, and implement a strategy for advancing geographic information and related spatial data activities appropriate to their mission, in support of the NSDI Strategy. [...]
- (2) Collect, maintain, disseminate, and preserve spatial information such that the resulting data, information, or products can be readily shared with other federal agencies and non-federal users, and promote data integration between all sources. [...]
- (4) Use FGDC data standards, FGDC Content Standards for Digital Geospatial Metadata, and other appropriate open standards, documenting spatial data with the relevant metadata, and making metadata available online through a registered NSDI-compatible Clearinghouse node. [...]

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[ 1 ] In U.S. Federal law and policy, the terms "spatial", "geospatial", "geographic", "mapping", and "locational" when linked with the terms "data" or "information", and/or the terms "system" or "resource", are used interchangeably unless noted otherwise.

[ 2 ] Section 216 ("Common Protocols for Geographic Information Systems", Public Law 44 USC Ch 36) is part of the E-Government Act of 2002, available at <http://thomas.loc.gov/cgi-bin/query/z?c107:H.R.2458.ENR>

[ 3 ] OMB Circular A-16 (as revised in 2002) is available at [http://www.whitehouse.gov/omb/circulars/a016/a016\\_rev.html](http://www.whitehouse.gov/omb/circulars/a016/a016_rev.html)

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identify planned investments for spatial data and compliance with FGDC standards within the Exhibit 300 capital asset and business plan submission (see OMB Circular A-11, section 300)."

Third, you should know that choices on behalf of the Government in the selection of products and services are crucial to realizing the objectives of the NSDI and must comply with the associated Federal law and policy as cited above. Whether contracting for new development or acquiring commercial off-the shelf products or services, you must specify that particular products and services shall comply with the standards adopted by the FGDC [4].

## NSDI Depends on Open Standards

It is a key requirement of the NSDI that component data resources and software systems are able to interoperate using well-defined and commonly supported open standards. (see Interoperability Standards, right).

Implementation of the NSDI relies on common adoption of certain International Standards Organization (ISO) standards, such as ISO 3166 (place codes), ISO 23950 (information search and retrieval service), and ISO 19115 (documentation and representation), also recognized as American National Standards.

NSDI also depends on "Framework Data" standards developed through collaborative efforts facilitated by FGDC. These standards address seven themes of common digital geographic data: geodetic control, orthoimagery, elevation, transportation, hydrography, governmental units, and cadastral (land ownership).

In addition to complying with law and policy mandates, it makes business sense for an agency to acquire products and services that support open standards because doing so helps to leverage investments in many other products and services used by the agency. Support for open standards also allows an agency to gain synergies through use of data and services that may be openly accessible from sister agencies, other levels of government nationally and internationally, and from many sources outside of government. Exactly how an agency can specify compliance to open standards as part of the acquisition process is discussed in the following sections.

**Interoperability Standards** - NSDI is based on the principle of "interoperability", defined as assurance that differences among particular systems are not a barrier to accomplishing a specific task that spans those systems.

NSDI interoperability focuses on how system components interface with each other, thereby minimizing any impact on participating systems other than where such systems interface with other NSDI components.

Interoperability is realized in the NSDI as a "Services Oriented Architecture", a specific technique for systems interoperability best known as the underlying architecture of the Internet.

For reasons of public policy as well as efficiency, NSDI interoperability is achieved through open, non-proprietary standards, with preference to formal standards such as those approved by the International Standards Organization (ISO) or other accredited standards development organization.

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[ 4 ] The FGDC operates in accordance with OMB Circular A-119 which directs Federal agencies to consult with and participate in voluntary consensus standards bodies.

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## Guidelines for Specific NSDI Standards in Acquisitions

Any acquisition of software can be seen as the means to satisfy a particular set of functional requirements. For example, an acquisition of Internet search technology may be intended to satisfy the functional requirement of simplified public access to agency data and information resources. To identify whether NSDI standards may be relevant in this acquisition, one needs to look at what spatial requirements are involved in satisfying this particular functional requirement. In most cases, the functional requirement for public access to agency data and information will include spatial requirements. Yet, that need for NSDI standards supporting such spatial requirements would not be apparent to an agency buyer merely shopping among available Internet search technologies.

As noted above, the NSDI depends on certain FGDC-endorsed open standards, including new Framework Data standards. A list of the standards most relevant to government acquisition of information technology is given in Table 1, below. Wherever possible, vendors of products and services should indicate support for a specific standard using the identifier given in Table 1 (these identifiers will be registered in the component registry located at <http://www.core.gov>).

### Categories of Spatial Requirements

Table 1 is organized according to three categories of spatial requirements that can be identified within the functional requirements of a software acquisition. Understanding these categories will help an agency to acquire software that supports the relevant NSDI standards.

These are the three categories of spatial requirements [5] important for a software acquisition:

1. **Spatial Data Access and Visualization** - Spatial data are typically treated either as sets of discrete geometric features or as fields of measured values (called "coverages"). Examples of feature data include road networks and point locations of incidents. An image of the Earth surface is a coverage example. Visualization refers to the rendering of geographic information to create visually meaningful products such as maps.
2. **Metadata or Catalog Access** - Spatial metadata describe data or services in order to aid discovery and access by users. Metadata are usually stored in a catalog, and are made accessible to applications and services via catalog interfaces.
3. **Spatial Reference Systems and Place Codes** - Spatial reference systems identify geospatial locations, using either place names or numeric coordinates. Standards in this area are crucial for most geospatial data transfers and service invocations.

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[ 5 ] These categories follow the approach given in the FGDC Geospatial Interoperability Reference Model, available at <http://gai.fgdc.gov/girm/v1.1>

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**Table 1. Identifying NSDI Standards in Software Acquisitions**

<b>Spatial Data Access and Visualization</b>		
<i>Identifier</i>	<i>Description</i>	<i>Example Functional Requirements</i>
ISO 19128	Geographic information – Web Map Service (WMS). ISO 19128 defines network client and server interfaces supporting the creation and display of registered and superimposed map-like views of information, from multiple sources that may be remote and heterogeneous.	<ul style="list-style-type: none"> <li>• make a map showing information related to location</li> <li>• find people, events, or information by location</li> <li>• manage resources that are at places</li> <li>• correlate disparate information by location</li> <li>• communicate where events or objects are</li> <li>• track object movement through space</li> <li>• offer spatial data layers to be used for spatial analysis (e.g., socio-economic data)</li> </ul>
ISO 19123	Geographic Information - Schema for coverage geometry and functions, aka Web Coverage Service (WCS). ISO 19123 defines network client and server interfaces extending ISO 19128 (Web Map Service, WMS) to allow access to geospatial "coverages" that represent values or properties of geographic locations, rather than WMS generated maps (visualizations).	
ISO 19142	Geographic information – Web Feature Service (WFS). ISO 19142 defines network client and server interfaces supporting retrieval and update of geospatial data encoded in ISO 19136 (Geography Markup Language)	
ISO 19136	Geographic information -- Geography Markup Language (GML).	
<b>Metadata or Catalog Access</b>		
<i>Identifier</i>	<i>Description</i>	<i>Example Functional Requirements</i>
ISO 19115	Geographic Information - Metadata. Successor to the FGDC Content Standard for Digital Geospatial Metadata (CSDGM).	<ul style="list-style-type: none"> <li>• find available spatial data, coverages and maps useful for a specific purpose</li> <li>• check planned spatial data acquisitions</li> <li>• find associations between spatial data and other information</li> </ul>
ISO 23950	Information Search and Retrieval. ISO 23950, also known as ANSI Z39.50, defines network client and server interfaces for all manner of information search. The Geospatial Profile of ISO 23950 is at <a href="http://blueangeltech.com/Standards/GeoProfile/geo22.htm">http://blueangeltech.com/Standards/GeoProfile/geo22.htm</a>	

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<b>Spatial Reference Systems and Place Codes</b>		
<i>Identifier</i>	<i>Description</i>	<i>Example Functional Requirements</i>
ISO 3166	Country names and codes	<ul style="list-style-type: none"> <li>• designate a point or delineate an area on, above, or below the Earth surface</li> <li>• identify the place or location where a person, object, or event occurs</li> <li>• manage data or information that includes a place or location designation</li> <li>• analyze relationships among persons, objects, or events with reference to place or location</li> </ul>
ISO 6709	Standard representation of latitude, longitude and altitude for geographic point locations. ISO 6709 defines a syntax for expressing latitude, longitude, and altitude values	
ISO 19127	Geographic information -- Geodetic codes and parameters.	
ANSI INCITS 61-1986 (R2002)	extension of ISO 6709 syntax to the Universal Transverse Mercator (UTM) and State Plane projected coordinate reference systems [previously ANSI X3.61]	
ANSI INCITS 31-1988 (R2002)	U.S. counties [previously FIPS 6-4, ANSI X3.31]	
ANSI INCITS 38-1988 (R1999)	U.S. states and territories [was also known as FIPS 5-2, ANSI X3.38]	
ANSI INCITS 47-1988 (R2000)	places [previously FIPS 55, ANSI X3.47]	
ANSI INCITS 145-1986 (R2002)	Hydrological Unit Codes Codes for river basins and sub-basins are published through USGS Circular 878-A [previously ANSI X3.145]	
OMB Bulletin No. 05-02	Metropolitan and Micropolitan Statistical Area Definitions (see <a href="http://www.census.gov/population/www/estimates/metrodef.html">http://www.census.gov/population/www/estimates/metrodef.html</a> ) [previously FIPS 8-6]	
<p><b>Framework Data Standards</b> (in development as a multi-part American National Standard within InterNational Committee for Information Technology Standards (INCITS) Technical Committee L1, Geographic Information Systems)</p>		
Cadastral (land ownership) Data Content Standard		
Classification of Wetlands and Deepwater Habitats of the United States		
Vegetation Classification Standard		
Soil Geographic Data Standard		
Content Standard for Digital Orthoimagery		

# NSDI Standards in Software Acquisitions

## Specifying Open Standards in Acquisitions

As an example, an agency buyer may want to acquire a software product that displays maps using a Web browser. Such a capability is available in many software products but this agency buyer is aware of the NSDI and FGDC standards policy outlined above and intends to avoid products that support only vendor-specific interfaces. This buyer also understands that choosing a product that supports the "OGC Web Map Service" open standard would allow access to many thousands of map data resources worldwide. But, exactly how does this buyer discover which specific products will support this particular FGDC-endorsed open standard?

In order for agency buyers to easily select products and services supporting open standards, vendors need a way to tag each available item as to which open standards it supports. This tagging of products and services in the software market is much the same idea as the kind of "plug-compatibility" that buyers have long depended on when buying hardware components.

In 2005, a change to the guidance on government contracts specifies how vendors should tag their products so that buyers can easily check what interoperable standards are supported. The change is in a "NOTE to Offers" in the major source of product catalogs for commercial off-the-shelf software, "Schedule 70":

NOTE: Offerors are encouraged to identify within their software items any component interfaces that support open standard interoperability. An item's interface may be identified as interoperable on the basis of participation in a Government agency-sponsored program or in an independent organization program. Interfaces may be identified by reference to an interface registered in the component registry located at <http://www.core.gov>. [This appeared in Refresh #15, May 13, 2005: <http://fs2.eps.gov/EPSTData/GSA/Synopses/13/FCIS-JB-980001-B/part1-refresh-15.doc> ].

Schedule 70, managed by the General Services Administration, encompassed more than 4,000 negotiated contracts in 2004, and accounted for about \$11 billion in information technology sales to the government. Also, Schedule 70 contracts may be used by State, Tribal, local, or regional government entities, and by any local educational agency or institution of higher learning. This fact can be very important in that U.S. Federal systems often interoperate not only across agencies but with other levels of government, especially in the context of the National Spatial Data Infrastructure.

This simple change in the Schedule 70 guidance to software vendors could have profound consequences across the entire Government. Government organizations throughout the U.S. have been trying to enhance the effectiveness and efficiency of programs by promoting interoperability, and that is one of the basic tenets of the Federal Enterprise Architecture. This focus on interoperability also reflects a major trend in information technology toward ever greater modularization of complex systems. As modern systems are designed with component parts, it is essential that these parts are standardized in how they interoperate.

Now that vendors of off-the-shelf software can identify components that are designed to interoperate, governments can accelerate the move toward a more connected architecture where systems leverage each others' services. And, through greater interoperability governments may also realize synergies that lay unrecognized within a myriad of system stovepipes.