Federal Geospatial Segment Architecture Guidance

Version 1.0

September 1, 2010

Developed by the Federal Geographic Data Committee and the Geospatial Platform

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Government agencies provide many services, most of which are associated with a geographic location. The geographic element of a service may include an address, a place name, delivery route, or an area such as a city, state or watershed. Combining our understanding of the economic, environmental or social issues of a government service with their geographic element leads to improved government services, as well as the generation and use of geospatial information. Geospatial information can provide an operational context to enhance service delivery and to find and inform coincident-compatible or incompatible interests. Government agencies invest in geospatial information, policies, services and infrastructure to better meet their mission objectives; collectively this investment is referred to as a geospatial capability. These capabilities can be leveraged, extended or modified to support a wide range of agency needs.

The successful adoption of geospatial capabilities across Federal agencies is mixed. Some organizations have yet to link their business and location data together in their day-to-day operations. Others encounter hurdles such as infrastructure, security and resource constraints. Agencies with well-developed geospatial capabilities face different challenges such as integrating with other agencies, adapting to changes in technology and policy, and planning their growth with both mission and enterprise needs in mind. Enhancing the geospatial capabilities of all agencies is an important step towards a more transparent and place-based service delivery paradigm for the Federal community.

The Geospatial Line of Business (LoB) Architecture and Technology Work Group has developed this guidance document for Federal agencies to improve the design and deployment of geospatial capabilities. The guidance offers strategies for establishing goals, target designs, implementation guidance and utilization of shared resources and for re-useable and standards based capabilities.

This document provides information architects and executives the principles needed to:

- Enhance agency business processes with geospatial capabilities.
- Optimally collect, manage and utilize geospatial information in efficient and effective ways within an enterprise architecture.
- Leverage geospatial standards and coordination efforts to enable the sharing of geospatial resources across an organization and with partners and the public.
- Produce open, interoperable, discoverable, reusable and measurable services that limit redundancy while promoting maximum use.
- Implement common design principles that foster a broader Federal geospatial platform of shared and accessible capabilities.

This guidance is based on the Federal Enterprise Architecture (FEA) framework and on implementation guidance presented in the Federal Segment Architecture Methodology (FSAM). The goal of this document is to produce Federal geospatial capabilities that are cost-effective and cross-cutting. Recommendations are presented in Chapter 4 that highlight geospatial concepts within the segment architecture process and the implantation of the Geospatial Platform.

CHAPTER 1: INTRODUCTION

Delivery of government services can be improved by leveraging geospatial capabilities. These capabilities are made up of data resources, services, technology and defined business processes. The value of these capabilities to government, commercial and private interests is embedded throughout those sectors at all scales of use from local to national and international. The Federal geospatial sector plays an important role in building and sharing the data and services that underpin geospatial capabilities in the private, Non-Government Organization (NGO) and State and local government sector. Internet map services such as Google, Bing, and MapQuest are an example of this re-use pattern frequently found in the geospatial community. These resource providers integrate, apply and re-generate new data and services that reach far beyond the original intent of the Federal investment. The value of these Federal and non-Federal capabilities and the reliance that public and private sectors have on them reach nearly every citizen:

- In natural disasters, citizens and emergency responders need to know the nature, magnitude and timing of anticipated destruction in different areas, the location of victims and emergency facilities, the best and nearest evacuation routes and the actual patterns of damage by location after the hazard event has passed.
- Businesses need to know how much the consumer price index is rising in their operating area in order to establish fair annual salary increases or understand the geographic growth patterns of new consumer markets to properly plan business investments.
- Military veterans need to know what medical services are available in their community and where they can obtain more specialized care.
- Farmers can use the measured spatial and temporal trends in local climate to help make prudent decisions on future crop selections and irrigation needs.
- Citizens and legislators need to know the changing demographics in their communities as a result of immigration to guide wise decisions about where tax dollars must provide social services and how private investments should fund future development.
- Citizens and businesses have a vested interest in whether income tax laws and regulations are being equitably enforced in different regions of the country, e.g., how does the likelihood of being audited vary.

Geospatial capabilities largely exist independently across Federal agencies. Some are highly focused resources to meet a unique mission need while others are intended for re-use by a broad-base of constituents'. Past strategies for designing geospatial capabilities are represented by a patch-work approach that does not fully optimize the Federal Government's ability to coordinate and share capabilities. Advances in technology and the potential use of geospatial information have also exceeded the ability of many agencies and their partners to fully benefit from, manage and share these assets. Contributing factors include fiscal limitations, the size and professional development of the workforce, limited coordination across the Federal geospatial community and inconsistent approaches to design and deployment. This environment can lead to higher costs, duplication of resources and missed opportunities. The value of improved geospatial planning and design is evident in that annual agency expenditures on geospatial capabilities have been estimated in the range of hundreds of millions of dollars.

The Geospatial Platform

This Geospatial Platform is a new initiative to modernize the Nations approach to forming and maintaining robust geospatial capabilities in the Federal sector. The Geospatial Platform is a managed portfolio of common geospatial data, services and applications contributed and administered by trusted sources and hosted on a shared infrastructure, for use by government agencies and partners to meet their mission needs and the broader needs of the nation.

The Geospatial Platform is underpinned by:

- A segment architecture, aligned with the FEA that emphasizes re-use of open and interoperable standards and technology and supports increased access to geospatial data and services. Collaborative investment and portfolio management processes that enable Federal agencies to leverage resources and share the costs of shared geospatial services.
- A government focal point responsible and accountable for coordination and provision of data and services provided by the Geospatial Platform.
- Policies and governance structures to ensure sound management practices and effective partnerships that address the requirements of Federal, State and local agencies and Tribal organizations as well as Administration policy and agency missions.

The Geospatial Platform will include an operational environment where agencies and their partners can discover and use shared data, services and applications in support of the business of the government and its citizens. The target Geospatial Platform will be established as a services-oriented architecture based upon common, secure, interoperable and scalable open-standards based technologies. It will provide access to a range of geospatial capabilities including software, data and infrastructure.

The mission, business and requirements that define the Geospatial Platform will reflect the diversity of the stakeholder community it serves (i.e. Federal, State, local and Tribal governments, private sector, academia and citizens). The Geospatial Platform will serve as the vehicle to leverage the expertise of experienced geospatial organizations and the tools they develop to assist in meeting needs of other agencies. These tools include data and services that can be built once and used many times, resulting in efficiency, savings and enhanced geospatial capacity and utilization. Also the Web-based data, services and applications will be managed as a portfolio and delivered through trustworthy providers where the following characteristics are present:

- High quality and timely geospatial data, services and applications are easy to find and use by all levels of government, the private sector and communities of interest.
- Enterprise business needs and agency core mission requirements can be identified, planned, budgeted and exploited in a geospatial context.
- Long term costs of geo-information delivery and access are reduced and duplicative efforts are minimized.
- Business processes are optimized and knowledge management capabilities exist for locating geospatial data and obtaining services.
- Effective Commercial Off-the-Shelf (COTS) systems and contractual business support operations are acquired more efficiently and can replace legacy geospatial applications.

- Collaborative management of geospatial investments can be made more adaptable, proactive and inclusive.

Purpose

The purpose of this guidance is to outline a common approach to the planning and deployment of improved geospatial capabilities within the Federal Government. It provides program managers and architects strategies for program design and delivery using a segment architecture methodology. Presented are high-level actions, planning considerations and implementation recommendations to help the Federal enterprise leverage geospatial capabilities.

Objectives of this guidance include:

- Provide background on geospatial information and geospatial programs and how they can be leveraged to support a wide range of agency business.
- Present the business case for geospatial programs through the identification of key business drivers and benefits.
- Illustrate the key players and compliance initiatives involved in geospatial programs.
- Provide guidance on adoption of geospatial segment architecture methodology.
- Enhance the Geospatial Platform design process through expanded use of geospatial segment architecture.
- Prepare agencies to develop transition plans and activities that support a cohesive Geospatial Platform target design.
- Enumerate and provide references to technical standards that are applicable to geospatial programs.
- Expand interoperability and re-use.
- Identify cost savings from improved planning.
- Share lessons learned.

This guidance is for Federal Government personnel involved in program planning, design and implementation; however, it may also be a valuable resource for systems integrators and other organizations such as State, Tribal and local governments seeking improved interoperability with Federal geospatial programs. Federal agencies are at different stages in the implementation of their geospatial architectures and programs. As a result, they will need to approach segment development and alignment with the Geospatial Platform from varying perspectives.

Scope

The scope of this guidance covers the formation of Federal geospatial segment architecture for civilian and defense programs with unclassified assets. This includes programs within individual agencies and across multiple agencies, and those utilizing emerging information technology (IT) approaches such as software and storage as a service. Implementation specifics are provided only as lessons learned where available. It is anticipated that some programs involving partners outside the Federal Government will require alternative and/or additional strategies outside the scope of this document.

Addendums and revisions to this document will be necessary as the Federal geospatial enterprise matures and new information technology practices evolve. In the event that this document contradicts established Federal Government policies and standards, those documents take precedence.

References

More information on the Federal Enterprise Architecture can be found at: http://www.whitehouse.gov/omb/e-gov/fea/.

More information on the Federal Segment Architecture Methodology can be found at: http://www.fsam.gov/.

CHAPTER 2: GEOSPATIAL CAPABILITIES

This chapter provides background material on geospatial topics essential to discussing segment architecture. Included is a discussion of the cross-cutting nature of geospatial information as a business asset, how advances in technology are shaping the manner in which geospatial capabilities are implemented, geospatial policy origins and their implications and institutional support for geospatial coordination. Upon finishing this chapter, the reader will have an understanding of the uses for geospatial capabilities within government as well as their historical context and emerging direction. The reader will also have an appreciation for how geospatial capabilities can benefit from a common operational platform built on architecture, planning and guidance developed from prior efforts or best practices.

Geospatial as a Cross-Cutting Capability

Location is inherent in many endeavors. People frequently organize information using location as context – where they live, where they work or the location of the nearest bus stop. Furthermore, location is also extended spatially to encompass boundaries or other derivative measures – the extent of a school district, distance to relatives or the range of cell phone coverage. Location-based information is pervasive and can take many forms including place names, street addresses, highway names and markers, latitude-longitude coordinates and maps and images of places or resources of interest. It can be structured, stored or combined with other information resources in a variety of ways to answer many different questions related to "place." When location-based information is processed or integrated with other data to provide more descriptive spatial intelligence or analysis it becomes geospatial information and the data processed with it become geo-enabled (e.g., bathymetry).

Geospatial information, or geo-enabled data, are used in a variety of business processes. This includes asset and personnel management, natural resources, environmental and health management, transportation, homeland security, intelligence and defense. Some examples of geospatial information or geo-enabled data used for these business processes include property records, vehicle routes, species ranges, crime patterns, electronic health records, traffic congestion, utility networks, hazardous waste management, airspaces, watersheds, satellite and airborne imagery.

A common use of geospatial information is in emergency planning and response. For example, a forecast of the progression of the track and intensity of a hurricane is based on geospatial information represented as a map, as shown in Figure 1. Many sources of geospatial information were joined together to make this map: base maps of the political boundaries and place names, current position of the storm and the output and projected location coming from a hurricane prediction model. This map, and the data behind it, could be used in other software systems for display with other data, such as population, highway networks, evacuation routes, emergency facilities, etc. in support of emergency response.

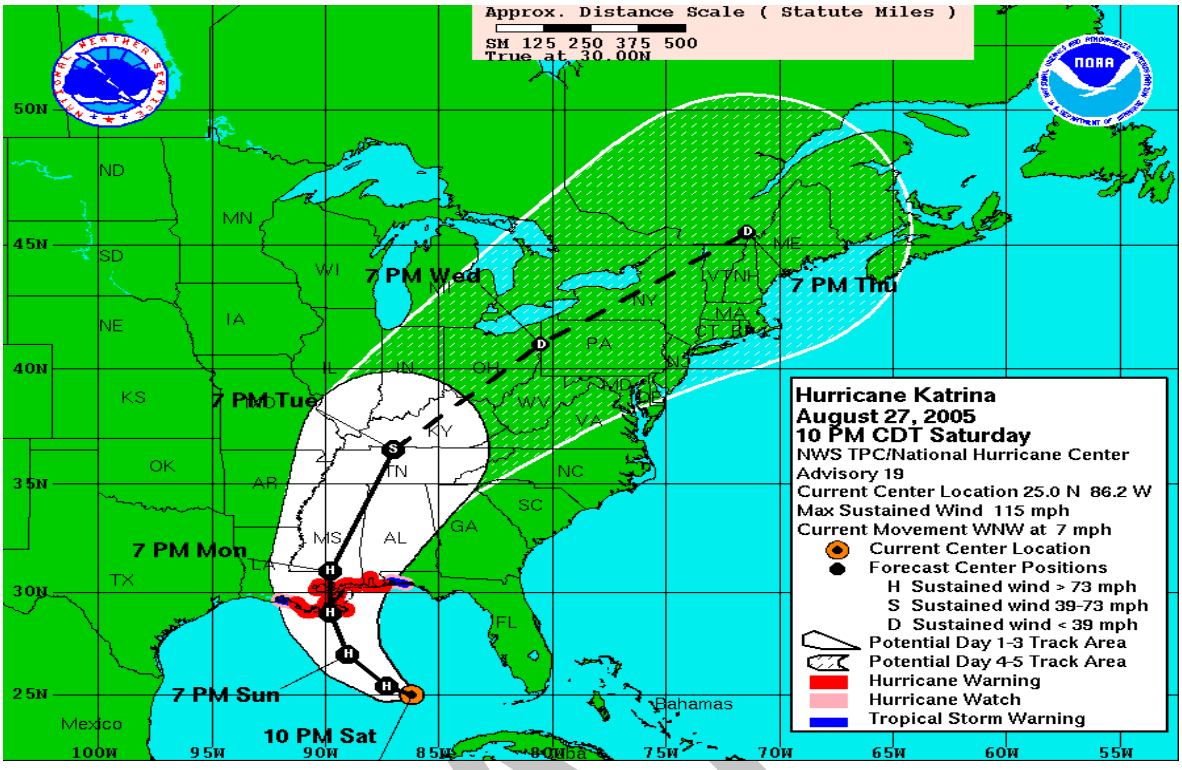


Figure 1: Predicted Path and Intensity of Hurricane Katrina over the Gulf Coast and Inland States

Hurricane Katrina response efforts required significant use and cross-agency collaboration of geospatial resources and represent a specific example of how the above benefits can be applied to real world situations. The geographic tagging of business data can be a key element in business process re-engineering, and can result in large returns on investment in terms of improved workflow and resource savings resulting from broader use.

Geospatial information includes not only information that is obvious to most people, such as driving routes and maps, but also other types of data, including elevation, satellite imagery and location information acquired from a global positioning system (GPS). Additionally, location is often an important feature of other types of information that many people may not think of as geospatial:

- Human resources systems capture the location of office buildings and rooms as well as home addresses for each employee, enabling optimal distribution of resources against a specific geography.
- Inventory and asset management systems generally identify where a piece of equipment is stored or used, enabling optimum utilization of assets from an enterprise perspective.
- Business performance reports often itemize results according to an organization's regions or jurisdictions, allowing for comparisons of performance between different organizational units and locations.
- Grants and funds to address specific community concerns are often distributed based on proximity to population centers or other relevant factors, maximizing the business utility of grants or funds to the population as a whole.

Other situations may require that a moving asset or phenomenon may be tracked according to its geographic location to enhance or optimize its business utility. Examples of a moving asset can include aircraft, trucks, vessels or even individuals on a watch list. Commercial shipping companies track every truck and package and can plan delivery routes to optimize or minimize travel distance.

Business operations based on the use of location, as well as collaboration facilitated through the effective use of geospatial information, can provide government and private sector organizations with many benefits, such as:

- Means for organizations to collaborate with other government agencies or organizations, particularly in times of emergencies or where rapid decisions are needed for business purposes.
- Improved sharing of geospatial information and services based on common semantics and functional capabilities, which foster geospatial partnerships contributing to inter-agency and inter-governmental interoperability.
- Transparency to the taxpayer. Empowerment of citizens occurs by providing visual tools they can use to make personal, family and business decisions.
- Enhanced availability of geospatial services and networks in the Web environment that facilitate development and use of geospatial information and functionality within organizations.
- Standards-based geospatial information resources created and documented using standards (e.g., metadata) by many organizations, making the resources accessible and usable to many others.
- Proven coordination mechanisms and examples of partnerships for shared data acquisition within the geospatial community to serve as models for those new to the use of geospatial resources.

Geospatial Technology

Technology that directly supports the development, modification, storage, use or dissemination of geospatial information is referred to as geospatial technology. This may include hardware, software, databases, network communications or any other IT resource that makes geospatial services possible. Geospatial technology may be developed specifically to support geospatial operations or may be generic in nature and support operations as an aspect of overall enterprise use. Numerous advances in technology over the last 30 years have contributed significantly to the ability to productively use geospatial information within business processes. Although these advances represent general improvements in the world of computing and networking, geospatial services would not have evolved as quickly without them. For example, the advances in both computer processing power and telecommunications capacity ensure that large and complex geospatial information can be processed in a more efficient and timely manner. Several of these advances are critical to geospatial architecture and are described in this section.

Geospatial technologies and information that were either completely unavailable, or costly and restricted to skilled and uniquely trained staff, are now widely available at reasonable or even no cost to millions of individuals. Non-expert professionals can now take advantage of geospatial information on the desktop and through the Web. The Web in particular is leading a

transformation in the availability and ease of use of location-based content or applications. Commercial vendors are rapidly leveraging geospatial technology into a variety of Web-based geographic services for consumers. The development of open platforms and standards, increases in technical interoperability and faster access to content have led to a dynamically expanding list of "mash-ups;" applications capable of providing new or enhanced geographic services or information. The integration of GPS technologies into common mobile applications is leading to an emerging culture of locational awareness. Users can leverage these capabilities to support a wealth of geographic-centric business processes identified within an agency's enterprise architecture.

The following sections outline some common geospatial technologies deployed within an agency enterprise geospatial program. These technologies have different roles within an enterprise but all contribute to the eventual deployment of geospatial capabilities.

Geographic Information Systems (GIS)

Geographic Information Systems (GIS) is often defined as the hardware, software and data needed to capture, manage, analyze and display geospatial information. GIS, originally known as "computer mapping," originated in the early 1960s. For many years, agencies that bought and attempted to use GIS software were faced with a significant level of effort to digitize or geo-code their data in a way that allowed the hardware and software to manipulate those data. Increased availability of data based on significant investments, thousands of organizations using GIS and the proliferation of means to share those data (e.g., via the Web) have made it far easier to access and use GIS software to address real issues.

Geographic Information Systems

Geographic Information Systems (GIS) software facilitates the combination, clipping, and processing of multiple coincident geographic datasets to support problem-solving. In this figure, three spatial datasets were numerically combined to create a new dataset that quantifies a model of plant species richness.

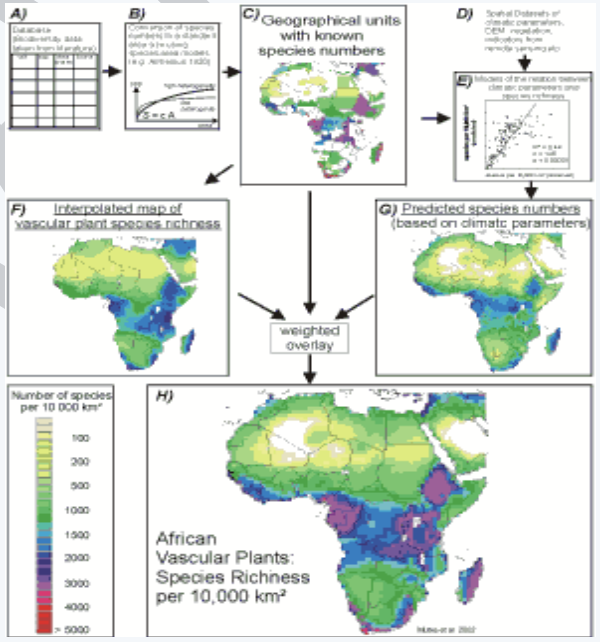


Figure 2: Use of Geographic Information Systems (GIS) to analyze plant species richness

Initially GIS was thought of only as a mapping tool, but unstructured maps (rather than data) served as a barrier to integrating geospatial analysis into operational business process. Over the last decade, software companies have increasingly added functionality to GIS and these tools now support complex data management and analytical functions through the desktop and the Web. The emergence of server based technologies and extraction of GIS business logic means organizations can craft custom GIS support applications for enterprise specific purposes.

Over the last decade, the cost of GIS hardware and software has decreased and the availability of enterprise licenses for geospatial software and data has increased significantly. This makes a variety of tools accessible to nearly any organization with the interest in managing data based on location.

Global Positioning System (GPS)

GPS is a satellite system that provides the means to capture highly accurate location information via GPS receivers. GPS devices package a receiver, often with basic mapping capabilities, in mobile hardware to allow for collection of location data. These location data are either uploaded via wireless networks or through office networks. A number of vendors have enhanced GPS services to provide better accuracy than the nominal 15 meters offered by GPS satellites natively. This supports the collection of more precise positions required by some business practices (e.g., facility management, emergency response). These capabilities allow agencies to affordably collect and then use or share location information where such positions are linked into the mission databases and systems.

Remote Sensing and Image Processing

Satellites and aircraft collect remotely sensed digital geospatial data in multiple spectra and image formats. These remotely sensed data provide a means to measure and examine features and phenomena on the Earth's surface. To leverage the analytical power and utility of these data, GIS and image processing software have evolved to not only provide support for manipulating or extracting information from remotely sensed geospatial datasets, but to also integrate them with other geospatial data formats for enhanced analysis or geographic visualization. Continuously increasing quantities of accessible and usable remotely sensed data offer rich opportunities to monitor trends, changes and characterize locations. Many commercial organizations have begun to use remotely sensed data in the services they are providing on the Internet, which leads to enhanced public visualization of geospatial information.

Geospatial Simulation Models

Advances in computer technology—processing speeds and storage, in particular—have made it possible to run complex models that rely on massive volumes of data. Many types of modeling applications are increasingly available (some at no cost) for different business purposes, including contaminant plume modeling, agricultural crop models, epidemiology, urban development and scenario simulation. Simulation models offer a geographic visualization capability for mission driven business processes.

Geospatial Web Services

Web services provide a standard means of interoperating between different software applications, running on a variety of platforms and/or frameworks. When geospatial parameters are applied, a Web service provides a means to support geospatial queries, analyses, intelligence and visualization over the Web. Combinations of data from different sources can be used to provide an integrated view over time of events, tracked entities and their locations to support decision-making during operational planning, preparedness, prevention, response and remediation. An example of such a Web service is the National Oceanic Atmospheric Administration (NOAA) Fire Weather Forecasting tool, as shown in Figure 3.

Geospatial Web services can be customized to support specific user requirements and represent cross-cutting business capabilities. Systems that process or provide geospatial information have tremendous potential to integrate seemingly disconnected activities and a variety of data sources. Geospatial services can be used to transform, manage or present geospatial information to users. Examples of geospatial services of potential use to many business applications and users include:

- Displays of agency information within a geospatial context to visualize situations or events in relation to other relevant geographic features and entities of interest.
- Determination and display of the geographic coordinates corresponding to an address (geo-coding) to assist with locating assets.
- Identification of routes and directions to provide context for navigating from one location to another.
- Queries to retrieve geospatial information based on regions and/or political boundaries to support geographic based analysis.
- Conversion of geographic data from one coordinate system to another to support geospatial data sharing.

Geospatial services may be made accessible to users through Web browsers, Web-based applications or desktop client applications. They can also be seen as producers that are made available to users, consumers or consuming applications.

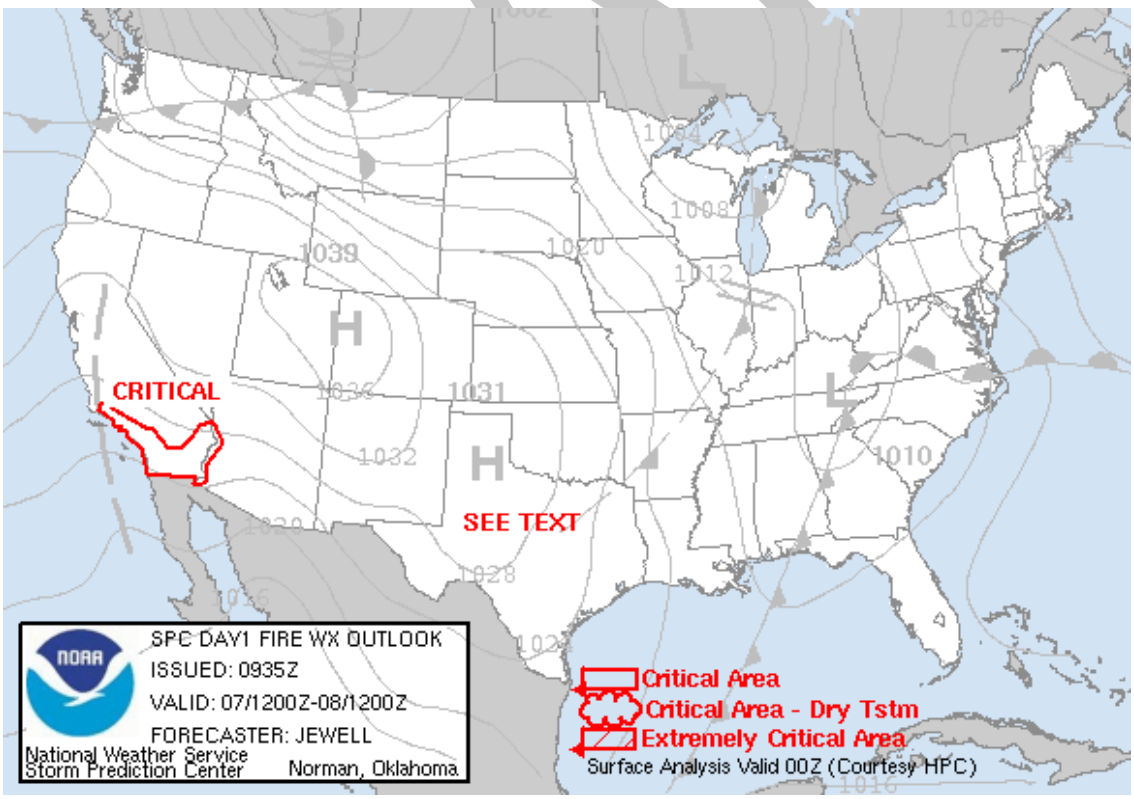


Figure 3: Fire Weather Forecasting - Example of a Geospatial Web Service

Virtual Geospatial Environments

Commercial vendors, the open source community and some government agencies have helped to popularize geospatial data as tangible business or personal information resources by releasing Web-mapping application programming interfaces (API's) and virtual globe services. Business owners and citizens now have a readily available source of geographic information and standardized geospatial capabilities to assist with location-based analysis.

Virtual globe services have opened new opportunities for geospatial analysis by offering three dimensional (3D) capabilities. For many agencies, vertical position is just as important to business services as horizontal position and the combination of both is required to adequately support operations. Further advances in geospatial virtual reality are possible where data sources such as Light Detection and Ranging (LIDAR) offer the fourth dimension component of time.

Virtual Alabama

In October 2005, the Alabama Department of Homeland Security initiated a project to access new technologies in 3D visualization. At the request of Governor Bob Riley, the Alabama Department of Homeland Security began exploring and identifying ways to leverage existing State asset imagery and infrastructure data into a visualization tool that is affordable, scalable, maintainable and capable of employing the power of existing and evolving internet based applications. As a result, the Virtual Alabama program was created.

Virtual Alabama leverages virtual globe technology to allow users to retrieve information from a merged global imagery dataset. In doing so, Virtual Alabama serves a wide user base of state and local officials at various levels of technological proficiency.

Source:

http://www.dhs.alabama.gov/virtual_alabama/home.aspx

Geospatial Goals and Objectives

The goals and objectives in this section were created as part of the geospatial segment architecture effort (described in full in Chapter 4). While they primarily focus on the role of the Federal Government in achieving the geospatial capabilities end-state, other key stakeholders have a crucial role in enabling interoperability and trust across the geospatial landscape to accomplish geospatial information sharing outside the Federal Governmental boundaries. These stakeholders, who are mentioned throughout this document, include external business and commercial entities wishing to conduct business with the Federal Government; academic and non-profit institutions; and State, local, and Tribal governments that require information exchanges to meet mission needs.

Goal 1: Comply with Federal Laws, Regulations, Standards and Governance Relevant to Geospatial Capabilities

This goal includes aligning and coordinating operations and policies to meet the laws, regulations, standards and other guidance in forming geospatial programs, aligning Federal agencies around common geospatial practices and where necessary, reviewing and aligning policies to ensure consistency.

Objective 1.1: Align and Coordinate Federal Policies and Key Initiatives Impacting Geospatial Implementation

The Office of Management and Budget (OMB) and the Federal Geographic Data Committee (FGDC), through the Geospatial Platform, have worked in a coordinated fashion to provide the policy context for geospatial implementation. As technology continues to evolve and geospatial programs modernize, the policy and key initiatives endorsed by OMB and FGDC will change accordingly. Cloud computing is of critical interest to OMB as a means for driving down infrastructure and service costs. The Geospatial LoB Architecture and Technology Work Group is actively conducting pilot studies to assess the ability for agencies to leverage the cloud as an implementation platform. The interest in cloud computing is a relatively recent phenomenon, and policy or implementation guidance will need to change to reflect best cloud computing practices for the Federal geospatial community.

The geospatial segment architecture is designed to provide a framework through which emerging Federal policies or initiatives, such as cloud computing, Data.gov, Open Government and the current Administration Priorities for place-based budgeting initiatives, can be addressed. It seeks to produce a standards based approach for geospatial program implementation and services deployment that ensures alignment and clarity with Federal policies or key initiatives.

Objective 1.2: Establish and Enforce Accountability for Geospatial Implementation to Governance Bodies

Necessary authority must be given to and exercised by the geospatial governance authorities to ensure accountability across the Federal Government in meeting its vision for geospatial capabilities. In addition to developing comprehensive guidance and standards in support of the geospatial segment architecture, the governance bodies must establish and track specific performance metrics. Each agency shares the responsibility for establishing the trust and interoperability processes necessary to achieve the geospatial vision/end state and may be asked to report status against performance metrics publicly.

Objective 1.3: Define and Manage Geospatial Standards

The geospatial community has long endorsed standards with the FGDC serving as the focal point for geospatial standards efforts. The FGDC identifies or develops geospatial data standards for implementing the National Spatial Data Infrastructure (NSDI)**,** in consultation and cooperation with State, local, and Tribal governments, the private sector and academic community, and, to the extent feasible, the international community. Geospatial data standards are developed by the FGDC only when no equivalent voluntary consensus standards exist, in accordance with OMB Circular A-119.

The geospatial segment architecture is designed to foster participation in and adherence with standards efforts. The degree to which geospatial implementers follow standards ensures a level of certainty in the end product and fosters trust with consumers. All data or architecture recommendations within the geospatial segment architecture not only align with standards endorsed by Federal or international standards communities, but also allow for agencies to define specific business practices within these standards for supporting mission needs. For example, the geospatial segment architecture aligns to the FGDC Content Standard for Digital Geospatial Metadata (CSDGM), Version 2. Agencies following the geospatial segment architecture can

align with this standard while also managing specific metadata practices in terms of content, terms, or development within their agencies.

Goal 2: Facilitate Access to Geospatial Capabilities

This goal includes improving the ability of government agencies to utilize and share geospatial information internally, with other agencies and with the public by leveraging collaborative methods, as well as open standards, flexible architectures and interoperable solutions.

Objective 2.1: Design Architectures so that Geospatial Capabilities can be easily Consumed or Leveraged

The degree to which geospatial segment architectures are constructed so that the capabilities they provide can be easily consumed or leveraged is central to greater adoption and more efficient business. The geospatial segment architecture focuses on removing stovepipes or stand-alone geospatial implementations that are remnants of prior technology constraints or outdated management practices. It promotes Web-based approaches to service delivery in concert with federated models of data storage or acquisition to provide geospatial implementers the opportunity to better offer geospatial capabilities throughout the Federal enterprise.

Objective 2.2: Implement Interoperable Solutions-Based on Open Standards

To align with geospatial segment architecture, Federal agencies should design, build and deploy solutions that are interoperable and leverage open standards. Interoperability increases the flexibility of a solution and allows it to be leveraged in different ways throughout the enterprise. Open standards are a conduit to interoperability by empowering technology developers to make complex spatial services accessible and useful with all kinds of applications. The Open Geospatial Consortium (OGC) develops standards to address interoperability issues with a focus on reducing the level of expertise required to use geospatial data. The Geospatial Segment Architecture Guidance leverages OGC standards where possible so that geospatial data types, formats, resolutions, coordinate transformations and semantics can be handled through services automatically and invisibly.

Objective 2.3: Participate in Open Government so that Geospatial Capabilities are Known, Understood and Available

Geospatial capabilities are ultimately utilized if they are known and understood by the end user. End users may be the public, other agencies or internal users within the agency hosting or deploying the capability. The geospatial segment recognizes that Open Government is an initiative that is still forming and that prior practices, such as publicly available metadata or service descriptions through Geospatial One Stop (GOS), should be considered under the Open Government umbrella. The goal is to develop architectures that can support a variety of existing or new methods for publicizing and describing geospatial capabilities leading to greater knowledge or adoption. Of particular interest is developing capabilities that can be consumed and used in different fashions than originally intended, i.e. “mash-ups”, which leverage the creative potential possible within the Federal or public domains.

Goal 3: Reduce Costs and Increase Efficiency

This goal includes allowing agencies to create (and maintain) geospatial architectures that deliver more information in a more convenient fashion while supporting appropriate security measures

at a lower cost. Establishing a clear vision through geospatial segment architecture is the first step towards achieving this goal.

Objective 3.1: Reduce Administrative Burden Associated with Performing Geospatial Tasks

Current geospatial programs may still rely on numerous manual, time consuming or convoluted data or service management processes. Through automation and streamlining processes, the Federal Government stands to significantly reduce the administrative burden and cost associated with various geospatial tasks. For instance, the legacy practice of manually administering user accounts/privileges on a system-by-system, user-by-user basis creates a great administrative burden.

Objective 3.2: Align and Reduce Programs

Geospatial segment architecture can be used to reduce or eliminate unplanned redundancy and occurrence of isolated programs or systems related to production, management or service delivery. Excessive implementation of highly focused solutions results in a higher management cost. Improved planning during the design phase can help determine the feasibility of a solution, as well as whether solutions already exist in the Federal landscape, to optimize program deployment.

Objective 3.3: Re-use Existing Geospatial Programs and Systems

Implementation of the geospatial segment architecture is intended to unify existing geospatial programs and initiatives, as well as agency-specific geospatial activities, under a common governance framework recognizing the unique role of each program in the overall structure, while eliminating redundancies and increasing interoperability between solutions. Again, planning and review should occur to fully evaluate whether existing geospatial resources within an agency or within the Federal Government can be re-used before deploying new capabilities.

Geospatial Governance

OMB Circulars, Presidential Executive Orders, and other strategic initiatives have guided geospatial programs and the management of information resources for approximately 50 years. The goal of the guidance is to improve creation, use and dissemination of geospatial resources across the Federal Government using various coordination mechanisms, such as the Geospatial Platform and this guidance document. These resources are important normative and informative references to consider when designing and building geospatial capabilities that can contribute to and benefit from a cohesive geospatial enterprise.

Office of Management Budget Policy and Directives

OMB policies and directives provide the policy framework for the development and use of common government investments in business and IT. Key polices and directives are listed below.

OMB Circular A–16

OMB Circular A-16 was first issued in 1953, and revised in 1967, 1990 and 2002. The purpose of the 1953 circular was “to insure (sic) that surveying and mapping activities may be directed toward meeting the needs of Federal and State agencies and the general public, and will be performed expeditiously, without duplication of effort.” OMB Circular A–16 describes the

management and reporting requirements in the acquisition, maintenance, distribution, use and preservation of geospatial data, including specifically the development of various common themes of data and metadata most prevalently used to support government business processes. Additionally, this Circular establishes and clarifies the responsibilities of the FGDC and development of the NSDI. The OMB Circular A-16 Supplemental Guidance defines portfolio based management of National Geospatial Data Asset (NGDA) Datasets and outlines how lead agency data architectures should leverage key NGDA Themes, as well as associated NGDA Datasets, as reliable sources of Federal geospatial data. A geospatial lexicon exists as a standalone reference to provide definitions of key geospatial terms and concepts including additional information about portfolios, themes, datasets and their relationship.

OMB Circular A–119

OMB Circular A-119 specifies that Federal agencies will develop their geospatial data and technologies in compliance with international voluntary consensus standards, as defined by the circular. Use of these standards enables consistency and increases the ability to share data and reproduce various analytical operations across organizations and countries.

OMB Circular A–130

OMB Circular A-130 directs that Federal agencies manage and make accessible to the public and other Federal agencies all public information (including geospatial resources) at no or low cost through established policies for the management of Federal information resources.

The E-Government Act of 2002

The E-Government Act of 2002 addresses geographic information in Section 216 (“Common Protocols for Geographic Information Systems”). The purpose is to reduce redundant data collection and information, and to promote collaboration and use of standards for government geographic information. Section 216 assigns responsibilities for common protocols for ensuring the compatibility, accessibility and interoperability of geographic information.

The OMB FEA Program Management Office’s (PMO) 2005–2006 Federal Enterprise Architecture Action Plan (March 2005)

The Federal Enterprise Architecture Plan includes a strategic initiative, “Create a Geospatial Profile,” which is described as follows: “The FEA Program Management Office (PMO) is supporting geospatial efforts through its FEA reference models and contribution towards establishing a Geospatial Profile. The FEA models will help define information in terms of a common service component that will assist in leveraging geospatial services across Federal, State, local and Tribal agencies. The purpose of a Geospatial Profile is to provide a consistent framework that can be applied within and across agencies to identify the geospatial implications across lines of business.”

OMB Memorandum M–06–07

OMB Memorandum M-06-07 requires the designation of a Senior Agency Official for Geospatial Information (SAOGI). OMB asked 27 executive departments and agencies to designate a SAOGI who has agency-wide responsibility, accountability and authority for geospatial information issues to assist agencies and ensure consistency across the government. Among other responsibilities, these individuals oversee, coordinate and facilitate their agency’s

implementation of geospatially-related requirements and represent their agency on the FGDC Steering Committee.

In February 2007, OMB directed 25 agencies to participate in the Geospatial LoB. The purpose of the Geospatial LoB is to ensure effective and efficient development of:

- Intergovernmental collaboration for geospatial-related activities and investments across all sectors and levels of government.
- Optimized and standardized common geospatial functions, services and processes that are responsive to customers.
- Cost efficient acquisition, processing and access to geospatial data and information.

The National Spatial Data Infrastructure

The NSDI was initiated by OMB in the early 1990s to develop the technology, policies, standards, human resources and related activities necessary to acquire, process, distribute, use, maintain and preserve geospatial data. Its goal is to enable geospatial data discovery and use from many sources (including Federal, State, local, and Tribal governments, academia and the private sector) so that the public or government agencies can enhance their understanding of the physical and cultural world.

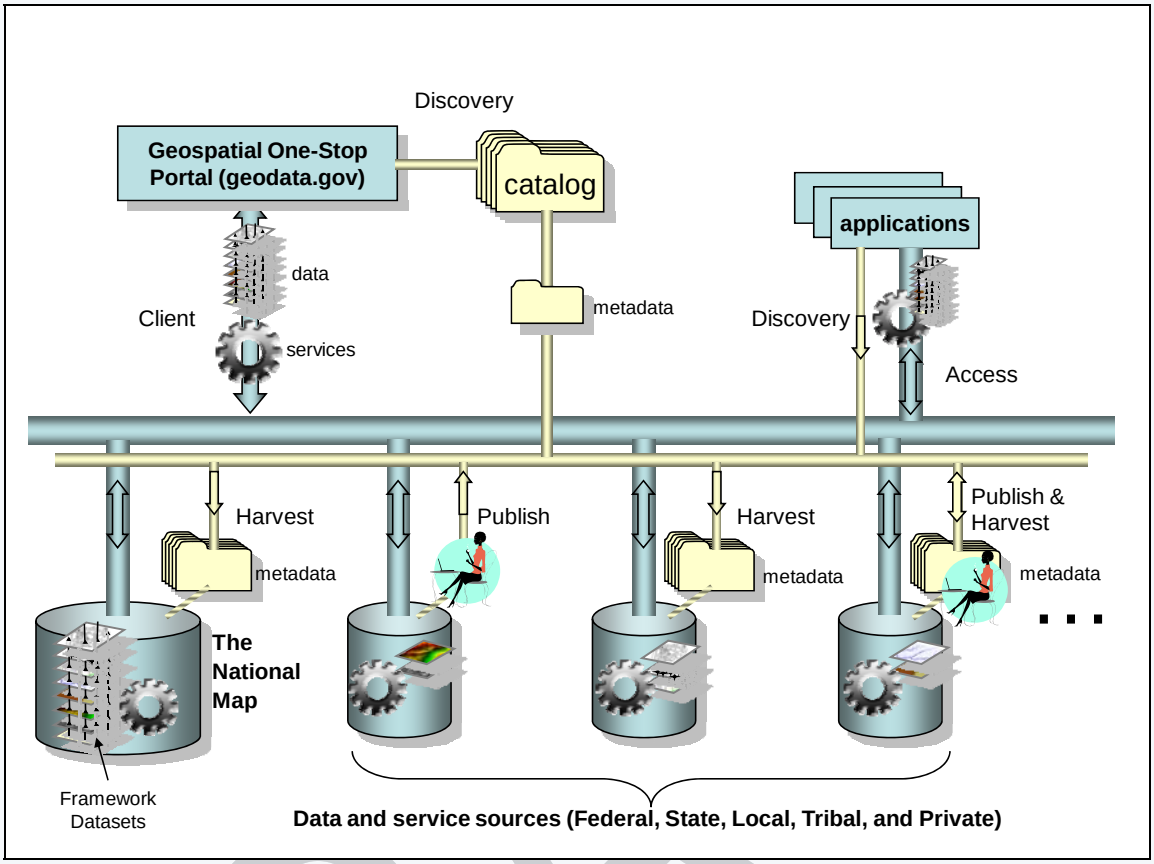
Executive Order 12906, issued in April 1994, outlined the major components of the NSDI, including a clearinghouse, framework data and metadata. All are considered part of the NSDI and need to be taken into consideration when developing agency enterprise architecture. The 2002 revision of the OMB Circular A-16 provides further development and clarification of the NSDI.

The FGDC, GOS and The National Map are three national geospatial initiatives that share the goal of building the NSDI. FGDC focuses on policy, standards and advocacy; GOS focuses on discovery and access; and The National Map focuses on providing integrated topographic base map content. The Geography Discipline of the United States Geological Survey (USGS) is the organizational host for these complementary activities.

In summary, the NSDI is intended to support the business of agencies and organizations as well as the needs of the public as follows:

- Provide access to geospatial data and services by Federal, State, local and Tribal agencies, private businesses, academic organizations, and the general public via implementation of the clearinghouse network, the National Map and GOS.
- Enable the widest possible use of geospatial data and services by ensuring that providers and users have knowledge of lineage, quality and security context of data and services through metadata.
- Facilitate sharing of data and services through standards and specifications for interoperability via the standards adopted by the FGDC.
- Provide a user-oriented delivery system enabling multiple means of delivery.
- Ensure that redundancy and waste are minimized via the sharing of data and services.

Conceptual Architecture of the NSDI



Key Technology Components of the NSDI

The "thin network (yellow pathway)" corresponds to the ability to discover, harvest and publish metadata, and can be thought of as the Clearinghouse network. Metadata can be published to the GOS catalog or a local metadata collection for review and retrieval by the public or government agencies. Local metadata can be harvested to populate another catalog, such as the GOS catalog. Local metadata collections or GOS can be searched via distributed search protocols to perform discovery on behalf of an application. Metadata can be published into any of the catalogs that allow this capability, and in this way, participants in the NSDI do not necessarily have to host a Clearinghouse node to participate as publishers of metadata.

The "thick network (blue pathway)" corresponds to the ability to access data and services made available via "common geographic protocols." The GOS Portal serves as a client allowing users to view data or services. Once a user knows that a dataset and/or a service exists which will meet their needs, their applications can then access the data or service through the NSDI and make use of it.

The National Spatial Data Clearinghouse is a secure electronic service providing access to documented geospatial data and metadata from distributed data sources nationwide, each with a catalog, describing their data and/or services. Under the various OMB and Executive Office initiatives, Federal agencies are required to use FGDC data content standards and the FGDC Content Standard for Digital Geospatial Metadata, and to make metadata available online through an NSDI-registered catalog. In addition to standards developed through Community Standards Development Organizations (SDO's) as defined by OMB Circular A-119, agency specific standards and protocols can also be applied to the geospatial data and services provided to NSDI.

Figure 4: Key Technology Components of the National Spatial Data Infrastructure (NSDI)

The Federal Geographic Data Committee

For the past 16 years, the FGDC has provided coordination for geospatial data activities at a national level. The FGDC has members from Federal departments and independent agencies and maintains liaison with non-Federal Governmental and professional organizations. The committee structure is composed of agency-led thematic subcommittees and working groups. Subcommittees are organized by data themes such as transportation, cadastral and hydrography. Working groups play a cross-cutting role, dealing with issues that span many of the subcommittees.

The FGDC facilitates the establishment and implementation of strategic guidance and specific actions that support improved collection, sharing, management, dissemination and use of geospatial data, as well as standards development. For example, the FGDC Standards Working Group actively promotes, coordinates and provides guidance on geospatial standards policy and procedures. It facilitates coordination among the FGDC subcommittees, and reviews and makes recommendations on the approval of standards proposals, draft standards for public review and draft standards for FGDC Steering Committee endorsement. The FGDC also advocates that Federal agency enterprise architectures leverage existing cross-agency resources such as GOS.

Geospatial One-Stop

E-Government Strategy identifies GOS as the component of the NSDI that provides a single-point of access to map-related data. It also provides the primary user interface to the NSDI Clearinghouse and serves as the catalog for dataset metadata records. A catalog for planned dataset acquisitions via a "marketplace" functionality is another component of GOS that enables users to coordinate and potentially share geospatial data acquisition costs. The GOS portal system has a catalog that contains the metadata records for datasets and planned data acquisitions. The portal also provides access to "geospatial services," such as Web-based mapping. GOS is compatible with and supports Data.gov through automated metadata harvesting from GOS to Data.gov.

Metadata records from Federal, State, local and Tribal governments can be accessed through GOS or Data.gov. Organizations contribute to GOS at their own discretion. The quality, context, content and accessibility of these data are conveyed through metadata prepared by the data provider and registered with the GOS catalog.

The National Map

The National Map is another key component of the NSDI. It contains many of the datasets associated with "framework" and other key themes described in OMB Circular A–16 generated by Federal agencies. The themes, and their respective datasets, are currently being consolidated and solidified by the Geospatial LoB Lifecycle Management Work Group. The National Map Web site offers geospatial datasets supporting NSDI in common geospatial data formats for ready use in mapping applications. Datasets currently in the National Map include:

- High-resolution digital orthorectified imagery from aerial photographs or satellite imagery that will provide some of the feature information now symbolized on topographic maps.
- Medium-resolution surface elevation (land) data.

- Vector data for hydrography (rivers and water bodies), transportation (roads, railways, and waterways), structures, government unit boundaries and publicly owned land boundaries.
- Geographic names for physical and cultural features to support the U.S. Board on Geographic Names and other names such as for highways and streets.
- Additional land attributes data (e.g., geology, land cover, land use).

Geospatial Standardization Organizations

There are several organizations that contribute to the effective use and sharing of geospatial data and services through standards and specification development. Standards supply an effective and consistent context for implementing geospatial capabilities and should be incorporated into agency architectural policy. While standards organizations provide a consistent framework upon which implementation approaches can be designed, the actual implementation, testing and adherence to standards is at an agency's discretion. Two of the major standards organizations are described below.

International Organization for Standardization (ISO) Technical Committee 211

The International Organization for Standardization (ISO) is the world's largest developer of standards. Within ISO, the Technical Committee 211 (ISO/TC 211) Geographic information/Geomatics is responsible for the geographic information series of ISO standards. It is the internationally recognized standards body for the geospatial community with representatives from 29 different countries. ISO/TC211 has published 32 standards related to digital geographic information. The International Committee on Information Technology Standards, Committee L1 (INCITS L1) is the U.S. Technical Advisory Group to ISO/TC 211. The work of L1 consists of adopting or adapting information technology standards and developing digital geographic data standards.

Open Geospatial Consortium (OGC®)

The Open Geospatial Consortium (OGC®) is a non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial and location-based services (LBS). The OGC represents an industry consortium of over 300 companies, government agencies and universities participating in a consensus process to develop publicly available interface specifications. OpenGIS® specifications support interoperable solutions that geo-enable the Web, wireless and LBS and mainstream IT. The specifications empower technology developers to make complex spatial information and services accessible and useful within a wide variety of applications.

References

More information on NOAA's Fire Weather Forecasting Web Service can be found at: http://www.spc.noaa.gov/exper/firecomp/sw/.

While FGDC has not officially adopted the North American Profile (NAP) of ISO 19115:2003 as a standard for metadata, it is the likely successor to CSDGM Version 2.0. More information about NAP can be found at: http://www.fgdc.gov/standards/projects/incits-l1-standards-projects/NAP-Metadata/napMetadataProfileV101.pdf/view.

More information on the Open Geospatial Consortiums Web Service Architecture description can be found at: http://www.w3.org/TR/ws-arch/.

More information on Office of Management and Budget (OMB) Circular A-16 Revised can be found at: http://www.whitehouse.gov/omb/circulars/a016/a016_rev.html.

National Geospatial Data Asset (NGDA) Themes are synonymous with OMB Circular A-16 Themes; an organizational construct under which multiple and related NGDA datasets are grouped logically and managed as a unit. A portfolio consists of a group of NGDA themes each of which is comprised of NGDA datasets. The datasets are selected from a larger and continually changing universe of geospatial datasets because they meet inclusion criteria. A dataset that has been designated as such by the FGDC Steering Committee and meets at least one of the following criteria: Supports mission goals of multiple Federal agencies; statutorily mandated; Supports Presidential priorities as expressed by Executive Order or by the OMB.

More information on the OMB Circular A-16 Supplemental Guidance Lexicon of Geospatial Terminology can be found at: http://www.fgdc.gov/policyandplanning/A16Draft/A16_SG_Lexicon.

More information on the OMB Circular A-119 Revised can be found at: http://www.whitehouse.gov/omb/circulars/a119/a119.html.

More information on the OMB Circular A-130 can be found at: http://www.whitehouse.gov/omb/circulars/a130/a130trans4.pdf.

More information on the E-Government Act of 2002, specifically Section 216 ("Common Protocols for Geographic Information Systems," Public Law 107-347) can be found at: http://www.gpoaccess.gov/serialset/cdocuments/sd107-18/pdf/pl107-347.pdf.

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.

More information on the 2005 – 2006 Federal Enterprise Architecture Program Management Office Action Plan can be found at: http://www.enterprise-architecture.info/Images/Documents/2005_FEA_PMO_Action_Plan_FINAL.pdf.

More information on Executive Order 12906 Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure can be found at: http://govinfo.library.unt.edu/npr/library/direct/orders/20fa.html.

More information on the Federal Geographic Data Committee can be found at: www.fgdc.gov.

More information on the E-Government Strategy can be found at: http://georgewbush-whitehouse.archives.gov/omb/egov/g-3-statement.html.

More information on Geospatial One Stop can be found at: http://www.geodata.gov.

More information on The National Map can be found at: http://nationalmap.gov/.

Orthorectification is the process of transforming raw imagery to an accurate orthogonal projection. Without orthorectification, scale is not constant in the image and accurate measurements of distance and direction cannot be made.

More information on the U.S. Board on Geographic Names can be found at: http://geonames.usgs.gov/.

More information on the International Organization for Standardization Technical Committee 21: Geographic information/Geomatics can be found at: http://www.isotc211.org/.

More information on the 32 different standards published by the International Organization for Standardization Technical Committee 21 can be found at: http://www.iso.org/iso/standards_development/technical_committees/list_of_iso_technical_committees.htm.

More information on the Open Geospatial Consortium, Inc can be found at: http://www.opengeospatial.org.

More information of the Open Government Initiative can be found at: http://www.whitehouse.gov/open

CHAPTER 3: FEDERAL ENTERPRISE ARCHITECTURE

Enterprise architecture is a management practice to maximize the contribution of an agency's resources, IT investments and system development activities to achieve its performance goals. Architecture describes clear relationships from strategic goals and objectives through investments to measurable performance improvements for the entire enterprise or a portion (or segment) of the enterprise.

The FEA uses five reference models: Performance, Business, Data, Service and Technology to describe and improve IT investments within the Federal Government. These models are interrelated and mapped to one another to illustrate the ways in which the different aspects of the architecture impact each other. Models provide taxonomy to convey the architecture for segment and solution planning and implementation. The FEA reference models are instructive to developing geospatial segments and to facilitate cross-agency optimization of IT resources. See Figure 5 for an overview of reference model content and associations.

Figure 5: Reference Models

Performance Architecture

Performance architecture defines the indicators, measures and metrics used to gage the success of a product, service or transition of a technology investment to a desired configuration. Performance indicators are used to measure in the following six areas:

- Mission and Business.
- Customer Services.
- Process Automation.
- Technology.
- Human Capital.
- Other Fixed Assets.

Performance results can then be used to take corrective action such as improving alignment between inputs and outputs, measure resource contributions to specific mission value and

influence strategic objectives. Improved performance is realized through better metrics, greater focus on mission, agreement on goals and objectives and timely reporting of results.

Performance architecture frequently "book ends" the architectural development process, with the definition of strategic goals and objectives, as well as review of existing resources, occurring in the earliest stages and the refinement and acceptance of performance metrics occurring as one of the last steps in creating the transition plan.

Business Architecture

The business architecture is a functional perspective of Federal Government operations. The purpose of the business architecture is to identify common government lines of business that form the enterprise independent of organizational structure or technology practices. The business architecture provides the functional context to which data, service components and technology at the lower layers of the architecture can be applied. The business architecture reference model contains four topic areas used to drive the development of business architecture products. These areas include: service sectors, service delivery mechanisms, service support and resource management. Business architecture products can be developed from the architecture process and include Value Chain Analysis, Service Sector Definitions and Use Cases.

Value Chain Analysis

Value chains identify the full life cycle of events from the concept of a product or service through its development to delivery. Each step in the chain provides some value to the product or service. Value chain analysis can be used to improve product and service delivery, as well as categorize the addition of value through each step. Value chain performance can be affected by infrastructure, human resources, technology and procurements. An example of a business value chain is presented in Figure 6 below.

Figure 6: Business Value Chain for Federal Geospatial Services

Service Sector Definition

Service sectors define the general subject area that a government business process or product serves. Examples include energy, transportation, economic development and education, and available, specific sub-fields within the service sector. The E-Government delivery models listed below are an additional architectural designation useful for service sector definition where geospatial values are realized:

- Government to Citizen – Aims to facilitate interaction between government and the American public.
- Government to Business – Drives interaction between agencies and the private sector.

- Government to Government – Fosters the development of inter-agency relationships and information sharing across all levels of government (Federal, State, local and Tribal).
- Internal Efficiency and Effectiveness – Drives internal agency processes and activities to become more friendly, convenient, transparent and cost-effective.

Use Cases

Use Cases describe the interaction between a consumer and a business or system resource that is providing a service or product. The purpose of the Use Case is to identify the sequence of functional steps the consumer is exposed to and what each function needs to provide. Use Cases are commonly applied to evaluate and improve business delivery through system and work flow optimization. Use Cases can describe an existing or desired state condition. Example use case topics within the Federal geospatial enterprise context include:

- Acquire or create geospatial information.
- Store and manage geospatial assets.
- Use geospatial information to support business driven applications.
- Process geospatial information to maintain or update resources.
- Find geospatial information or services.
- Publish or disseminate geospatial resources.

Data Architecture

Data architecture provides a means to consistently describe, categorize, manage and share data and information assets across the Federal Government. Varying methodologies and technologies can be used to implement data architecture as long as it is based on the principles of the data reference model. Data architecture products evolve from the three data reference model standardization areas:

- Data Description – A means to uniformly describe data. Examples include the implementation of standards like CSDGM, entity relationship diagrams and data dictionaries.
- Data Context – The semantic content of data is defined using taxonomies and content standards. Examples include the OGC Implementation Specification for Geographic Information - Simple feature access, ISO/TC 211 Standard representation of geographic point location by coordinates and the FGDC Postal Address Data Standard.
- Data Sharing – The definition of messaging and exchange protocols, and the resources needed to affect ad-hoc queries. Example implementations in the geospatial community include specifications from, Open Geospatial Consortium, FGDC and American National Standards Institute (ANSI), Request for Comments (RFC) 4627/JavaScript Object Notation and the National Information Exchange Model (NIEM).

Example products or implementations of the data architecture process include clearinghouses of geospatial data. These contain enumerations of the content, structure and format of data, methods of access and serve one or more service sectors in an E-Government delivery model.

Clearinghouses are a fundamental component of the NSDI and are a part of the OMB Circular A-16 Supplemental Guidance. Example clearinghouses include:

- GOS.
- The National Map.
- Data.gov.
- Global Earth Observing System of Systems (GEOSS).

Service Architecture

The service architecture classifies service components according to their support for a business or performance objective. Service components are independent of business functions and can be used to optimize IT services across organizational and business domains. This model helps managers or architects understand the geospatial services delivered by the government and assess whether there is an opportunity to aggregate like services and streamline business deployment. The service reference model is decomposed in service domains, service types and service components.

Service Domains

A Service Domain is a coarse collection of processes or resources that operate together to meet the business needs of a service sector or community of interest. Service domains can originate from reference models such as the FEA Service Component Reference Model, the OGC Reference Model, and the ISO/DIS 19101 Geographic Information Reference Model.

The FEA Service Domains are differentiated by their business oriented capabilities such as Customer Services, Process Automation Services, Business Management Services, Digital Asset Services, Business Analytical Services, Back Office Services and Support Services.

Service Types

Service Types are a collection of services that are tied to a single service domain.

Service Component

A Service Component is a self-contained business process or application with its functionality exposed through a technology interface. Components implement services. Service components maybe stitched together in multiple configurations to serve one or more members of a service type.

Technology Architecture

The technical architecture defines the protocols for service access, interfaces for systems integration and platforms and infrastructure needed to implement the services component. The technical architecture is used to describe the proposed solutions using a consistent and well defined model. Technical architecture products are built using the technical architecture reference models, and include examples such as as-is system interface diagrams and planned or target system interface diagrams.

As-is System Interface Diagrams

Geospatial capabilities are planned and deployed using a myriad of processes, technologies and standards across the Federal Government. Often these are autonomous efforts driven by widely varying needs. The discrepancy between the methods can lead to failures in interoperability, one-off designs, duplicate efforts and difficulty finding authoritative data sources. These differences pose a significant challenge in defining a cohesive geospatial capability at any level of government. As-is systems interface diagrams can be used to identify these deficiencies. Figure 7 shows an example of high-level view of an as-is interface diagram highlighting a fractured implementation of geospatial services.

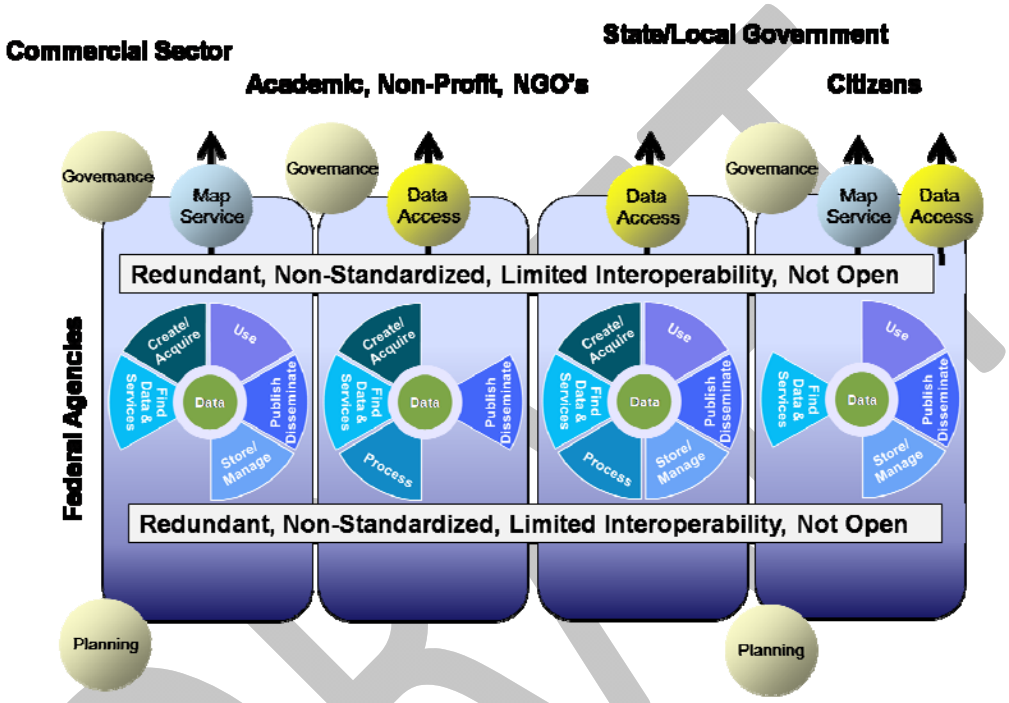


Figure 7: As-is View of the Federal Geospatial Community

Target Conceptual Diagrams

This is an architectural product used to model and optimize future configurations of geospatial enterprise services. These can be successfully applied at varying scales of architecture, and can contribute to expanded use of common service resources and the expansion of internal and external interfaces. See the example below of an optimized technical architecture.

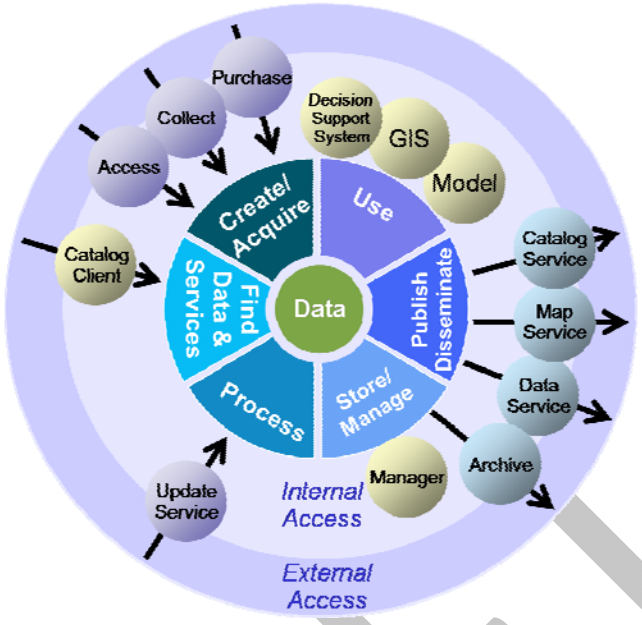


Figure 8: Target Re-alignment for Agency Geospatial Technical Architecture

The diagram in Figure 8 represents an agency, or group within an agency, operating within a broader spatial data sharing community. The degree of interaction through external access is correlated with heightened and more efficient information exchange. This circumstance occurs when the organization in the diagram is able to re-use an authoritative data source from an external provider. Arrows show the information flow. Note the ability to serve information in multiple open and interoperable forms from a variety of distributed data stores as well as allow for multiple methods for updates. This flexibility allows organizations to integrate or extend geospatial data, moving it from 2D or 3D states to include 4D (time) or 5D (depth) components. Through implementation of common processes and interfaces for managing, accessing and leveraging data stores, the target conceptual diagram process can reduce stovepipes, eliminate closed systems and offer more effective methods for information management, acquisition and distribution. Standardized services are used as the conduit for connecting distributed systems or data stores. This target conceptual design complies with Federal directives by including the main functions from OMB Circular A-130 (except governance and disposition).

Figure 9 illustrates how the target geospatial technical architecture sits within and supports the broader Federal geospatial community.

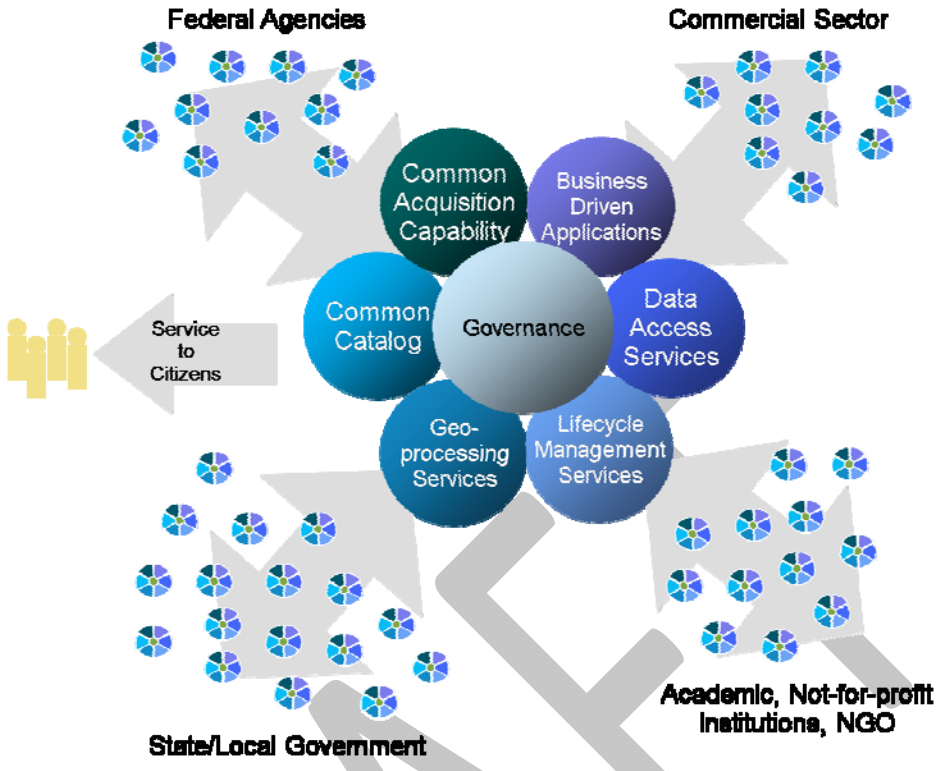


Figure 9: Target Geospatial Technical Architecture Applied to Broader Federal Community

Figure 9 depicts the distributed community of providers/consumers/partners in the Federal geospatial domain. Each sub-community or sector has its own means of interaction but the entire community of all sectors shares a core, common governance model to define roles and responsibilities as well as standards, implementation guidance and planning/investment activities. Data, services and capabilities are shared as part of a Federal geospatial enterprise. The outputs and inputs from the agency/organizational target view fit into each larger platform circle in the broader Federal community view, i.e. an organizational data service is part of the Federal data access services.

Effective governance is an important success factor for scaling and adapting a target design to the broader Federal geospatial community. Mechanisms need to exist whereby providers, consumers and partners can find and understand the resources available to them across the Federal space before investing in or implementing similar capabilities. Once discovered, geospatial information or services need to be available in a standardized fashion which promotes re-use or adoption. Feedback is required to allow participants to assess the effectiveness of services and allow for improvement.

Architecture Levels

Enterprise, segment and solution architecture provide different perspectives by varying the level of detail and priorities placed on any one topic. Each type of architecture uses a hierarchal methodology. Figure 10 illustrates the relationships between enterprise architecture, segment architecture and solution architecture.

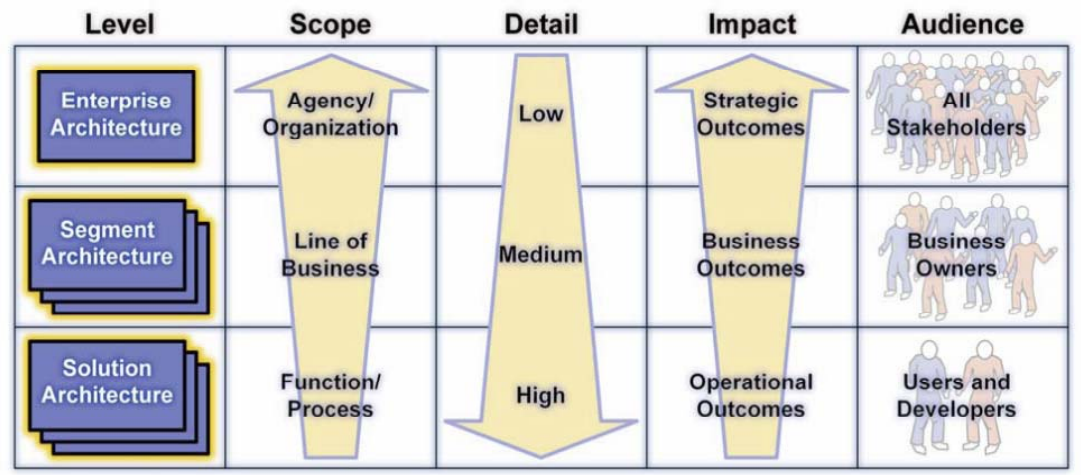


Figure 10: Architectural Levels

Enterprise

Enterprise architecture is fundamentally concerned with identifying common or shared assets – whether they are strategies, business processes, investments, data, systems or technologies. Enterprise architecture is driven by strategy; it helps an agency identify whether its resources are properly aligned to the agency mission and strategic goals and objectives. From an investment perspective, enterprise architecture is used to drive decisions about the IT investment portfolio as a whole. Consequently, the primary stakeholders of the enterprise architecture are the senior managers and executives tasked with ensuring the agency fulfills its mission as effectively and efficiently as possible.

Segment

Segment architecture defines a simple roadmap for a core mission area, business service or enterprise service. Segment architecture is driven by business management and delivers products that improve the delivery of services to citizens and agency staff. From an investment perspective, segment architecture drives decisions for a business case, group of business cases supporting a core mission area or common or shared service. The primary stakeholders for segment architecture are business owners and managers.

Segment architecture is related to enterprise architecture through three principles: structure, re-use and alignment. Segment architecture inherits the framework used by the enterprise architecture and can be specialized to meet the specific needs of a core mission area or common and/or shared service. Segment architecture also re-uses important assets defined at the enterprise level including data, common business processes, investments, applications and technologies. Segment architecture also aligns with elements defined at the enterprise level, such as business strategies, mandates, standards and performance goals.

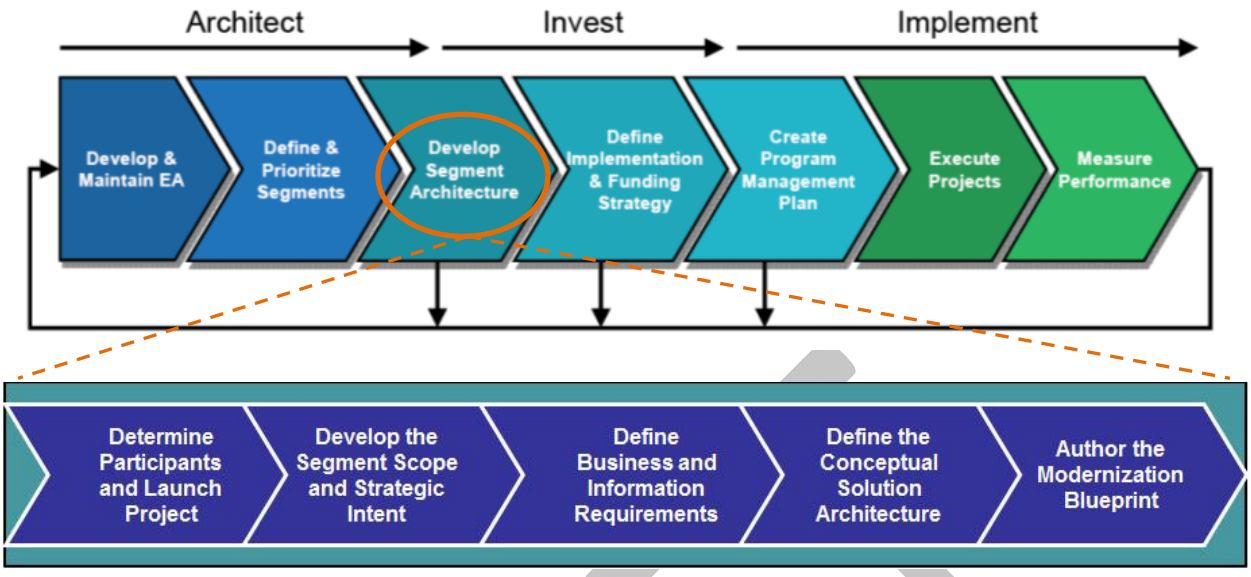


Figure 11: Segment Architecture

Solution

Solution architecture defines agency IT assets such as applications or components used to automate and improve individual agency business functions. The scope of solution architecture is typically limited to a single project and is used to implement all or part of a system or business solution. The primary stakeholders for solution architecture are system users and developers.

Solution architecture is commonly related to segment architecture and enterprise architecture through definitions and constraints. For example, segment architecture provides definitions of data or service interfaces used within a core mission area or service, which are accessed by individual solutions. Equally, a solution may be constrained to specific technologies and standards that are defined at the enterprise level.

Geospatial Platform

The Geospatial Platform will offer a managed portfolio of common geospatial data, services and applications contributed and administered by trusted sources and hosted on a shared infrastructure. The Geospatial Platform's shared resources will be easily accessible, through GeoPlatform.gov, to support the Administration's priorities, enhance mission critical operations, improve analysis and support business needs. By delivering trusted assets that are "built once and used many times," the Geospatial Platform will increase information sharing across various levels of government and industry, allowing for the re-use and adaptation of geospatial resources. This repurposing and availability of resources will lead to cost-savings, wider use of geospatial capabilities and higher quality software, data and infrastructure.

The Geospatial Platform is the next generation of Federal geospatial resource management, building upon the successes of the National Map, GOS, the Geospatial LoB and numerous other ongoing interagency geospatial initiatives. Its operations will complement current Administration initiatives such as Data.gov and the modernization of Federal IT. The Geospatial Platform fundamentally improves access to and management of geospatial resources through a focus on five key components, or Pillars, that support its implementation.

Common Data, Services and Applications

The Geospatial Platform will deliver trusted geospatial data, services and applications that are valuable to multiple agencies or customers to meet their business requirements. These common services will be registered and discoverable through the Geospatial Platform.

Shared Infrastructure

The Geospatial Platform will promote and foster utilization of IT components and shared investments across multiple partner organizations for joint development, operations and maintenance of common geospatial services.

Segment Architecture

The Geospatial Platform components will be designed and deployed through a process-driven approach that can be readily deployed in solution architectures by partners that collaborate on geospatial data and services.

Governance

The Geospatial Platform will implement processes by which parties with a stake in the Geospatial Platform are afforded an opportunity to shape its structure, functions and capabilities.

Portfolio Management

The Geospatial Platform will support the prioritization, selection and allocation of resources to maximize enterprise value in geospatial data, services and applications to obtain the best possible strategic impact of each investment.

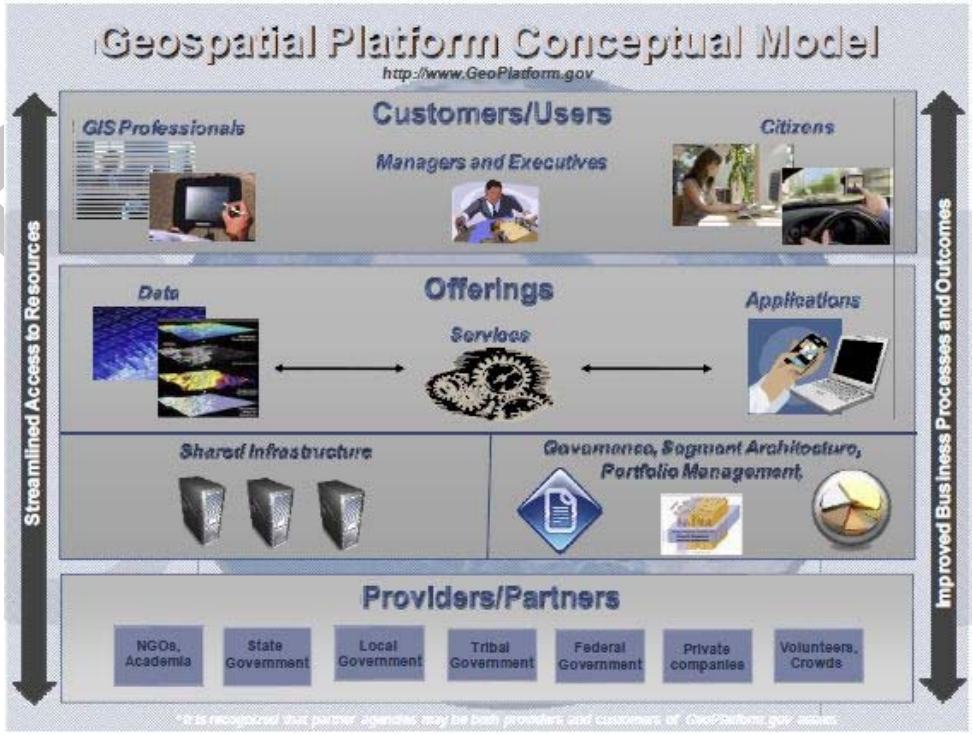


Figure 12: Geospatial Platform Conceptual Model

Geospatial Platform Segment Architecture

The five Pillars of the Geospatial Platform support a shared infrastructure which is enabled in part, through agency alignment with the target geospatial technical architecture. The Geospatial Segment Architecture Guidance is part of the Geospatial Platform Segment Architecture Pillar and informs the Geospatial Platform design.

The Geospatial Platform segment architecture is a dynamic environment. Multiple segments form the Geospatial Platform, all capable of maturing at different rates. Lessons learned from any one segment may inform and enhance future data, services and applications across many other segments. FSAM principles are applied to illustrate gaps and outline migration from the current state to the target state. In this fashion, the Geospatial Segment Architecture Guidance becomes a living document, continually refining migration from current to future target technical architectures.

Foundational Principles that form the basis for an efficient and cost-effective Geospatial Platform architecture include:

- Agreement on a common architectural style (i.e. a service-oriented architecture).
- Support for open standards for data content, format, protocol and service accessibility.
- Commitment to a design process that can be readily deployed by agencies as a solution architecture, while allowing partners to choose their own development methodology.
- Transparency of design, deployment and operation.

The Geospatial Platform segment architecture common engineering solution approach will:

- Facilitate the design, development and deployment of an effective and efficient Geospatial Platform segment architecture.
- Document common business processes, service components, technology standards and data and performance requirements.
- Enable the execution of a practical and operational community geospatial segment architecture based on common principles as solution architectures within broader agency architectures.

References

More information on OMB Circular A-130 can be found at:
http://www.whitehouse.gov/omb/Circulars_a130_a130trans4/.

More information on the FEA Practice Guidance can be found at:
https://docs.google.com/viewer?url=http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_Practice_Guidance_Nov_2007.pdf.

More information on the FICAM Roadmap and Implementation Guidance can be found at:
https://docs.google.com/viewer?url=http://www.idmanagement.gov/documents/FICAM_Roadmap_Implementation_Guidance.pdf.

More information on the Federal Enterprise Architecture Records Management Profile can be found at:
http://www.archives.gov/records-mgmt/policy/rm-profile.html.

More information on the FEA Consolidated Reference Model Document version 2.3 can be found at:
http://www.whitehouse.gov/omb/e-gov/fea/.

More information on the Modernization Roadmap for the Geospatial Platform can be found at: http://www.geoplatform.gov/.

More information on the Geospatial Line of Business Common Solutions and Target Architecture can be found at: http://www.fgdc.gov/geospatial-lob/CSTA-redacted-march2007.pdf.

CHAPTER 4: SEGMENT ARCHITECTURE IMPLEMENTATION

The intent of this guidance document section is to assist agencies in designing segment architectures that are aligned with a common Geospatial Platform architecture. Segment architecture principles are based on the FEA and provide a construct to develop Federal geospatial segments. The process of segment architecture development is defined by the FSAM, a five-step process with well-defined products. Agencies can use the FSAM process and products to improve their understanding of their as-is architecture, transition planning and the development of a conforming solution architecture. The segment approach also offers opportunities to improve input to the budget and strategic planning process as a result of greater transparency and consistency in the architectural products.

The Geospatial Platform will be composed of multiple geospatial segments from various agencies that work independently but share common design principles to provide a standard suite of services across the Federal enterprise.

The main objectives of the geospatial segment architecture are to promote a common deployment strategy for government-wide geospatial initiatives, streamline standards based implementations and align common systems development practices in the context of the Geospatial Platform. Implementation of the geospatial segment architecture within and between agencies will provide the means for agencies to collaborate on the development of shared solutions that meet individual needs while remaining consistent with current policy, guidance, standards and technical specifications.

FSAM Process Steps

- Determine Participants and Launch Project.
- Define the Segment Scope and Strategic Intent.
- Define Business and Information Requirements.
- Define the Conceptual Solution Architecture.
- Author the Modernization Blueprint.

Within each of the five process steps, the FSAM specifies a list of supporting and core outputs, (see Table 1) and provides sample templates. The FSAM was developed as a prescriptive methodology but was also designed to be flexible and extensible to allow for organization and segment specific adaptations. This guidance can be used to help apply the FSAM to geospatial segment architecture for:

- Consolidation or business processes transformation.
- Planning new systems.
- Enhancing existing systems.

A geospatial segment can form as either a cross cutting capability or as a core mission area. The FSAM can be used in both circumstances and to improve geospatial life cycle management practices and to improve business process driven use cases. The geospatial segment architecture process is typically formed at the agency level; special considerations need to be made when applying this approach across the entire Federal geospatial enterprise and its many organizations. Agency segment architectures should consider external systems interfaces wherever possible to

promote intra-and inter-agency exchange of geospatial data and access to common services. Included in this guidance are recommendations and references that highlight these key geospatial issues important to building the Geospatial Platform.

Summary of FSAM core outputs

Step	FSAM Product	Applicable Reference Models
1	Segment architecture purpose statement	P
2	Stakeholder map	B
2	Driver and policy map	P
2	Segment scope	P
2	Performance gaps	P
2	Strategic Improvement analysis	P
2	Segment performance goals and objectives	P
2	Performance scorecard	P
3	As-is business function model	B
3	Target business function model	B
3	Target conceptual data model	D
3	Target information flow diagram	B / D
3	Target data steward assignments	B / D
3	Target information sharing matrix	D
4	As-is conceptual solution architecture	B / S / T
4	Target conceptual solution architecture	B / S / T
4	Target service component architecture	S
4	Target technical architecture	T
4	Re-use summary	P / B / D / S / T
4	Data re-use	D
4	Recommendation sequencing milestones	P / B / D / S / T
5	Strategic systems migration /sequencing overview	S / T
5	Segment architecture blueprint document	P / B / D / S / T
5	Segment mappings	P / B / D / S / T

5	Transition plan milestones	P / B / D / S / T
	P=Performance, B=Business, D=Data, S=Service, T=Technology	

Table 1: FSAM Outputs

Step 1: Determine Participants and Launch Project

- **Activity 1.1:** Determine the executive sponsor.
- **Activity 1.2:** Develop the purpose statement for the agency geospatial segment.
- **Activity 1.3:** Solicit core team members.
- **Activity 1.4:** Create core team charter and project plan.
- **Activity 1.5:** Establish the communications strategy.

Core outcomes: Geospatial segment architecture purpose statement.

Recommendations:

- Use the Geospatial Platform Managing Partner and the Partner Network when defining project membership and purpose statement.
- Review existing agency geospatial blueprints or road maps to inform the purpose statement.
- Identify the strategic drivers to the proposed geospatial segment.
- Include a Geographic Information Officer (GIO), or their designate, as a member of the core team.
- Look for opportunities to leverage core team expertise from outside the Federal sector.
- Use existing communications practices in the geospatial community. Review availability of regular agency geospatial work group meetings, trade group meetings, conferences, web resources, etc.

Resources:

A-16 Stakeholders Roles and Responsibilities Table
http://www.fgdc.gov/policyandplanning/A16Draft/RolesandResponsibilities_Table

Bureau of Land Management Geospatial Services Strategic Plan FY2008
http://www.nps.gov/gis/egim/publications.html

EPA Geospatial Blueprint – A Strategic Plan for EPA's Geospatial Program
http://www.epa.gov/nscep/

Federal Transition Framework Catalog
http://www.whitehouse.gov/omb/e-gov/ftf/

Federal Geographic Information Officers
Address to be determined
http://www.fgdc.gov/participation/steering-committee/steering-committee-membership

Geospatial Modernization Blueprint – Recommendations and Architectures v. 1.0, U.S. Department of the Interior
http://www.doi.gov/ocio/architecture/modblu/geo/Geo_Blueprint_Public_Version.pdf

Information Technology Management Structure and Governance Framework
http://www.whitehouse.gov/sites/default/files/omb/assets/omb/memoranda/fy2009/m09-02.pdf

2010-2014 Geospatial Services Strategic Plan, U.S. Fish and Wildlife Service
http://www.fws.gov/GIS/policy/FWS_GIS_StrategicPlan_2010_signed.pdf

Geospatial Profile of the Federal Enterprise Architecture, version 2.0
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

National Geospatial Advisory Committee
http://www.fgdc.gov/ngac

Step 2: Determine the Segment Scope and Strategic Intent

- **Activity 2.1:** Establish geospatial segment scope and context.
- **Activity 2.2:** Identify and prioritize strategic improvement opportunities.
- **Activity 2.3:** Define agency geospatial segment strategic intent.
- **Activity 2.4:** Validate and communicate the scope and strategic intent.

Activity 2.1: Establish geospatial segment scope and context.

Core outcomes: Stakeholders map, business drivers and policy map and segment scope.

Recommendations:

- Use performance gaps, identified by the agency's strategic plan, Inspector General (IG) or U.S. Government Accountability Office (GAO) reports, and/or performance improvement assessments, as the driver for segment identification and prioritization.
- Identify new requirements and opportunities within the agency strategic plan and use these new requirements to expand existing segments or develop new segments.
- Integrate cross-agency initiatives using the Federal Transition Framework.
- Identify statutes, executive orders, regulations or agency plans that specifically control the acquisition or use of the location products or services.
- Examine existing location-based product and service use patterns among stakeholders.
- Evaluate integration points and dependencies of multi segment solutions.
- Consider segment integration in the context of multiple agency enterprise architectures.
- Examine existing geospatial segments that may serve part of the business process; consider circumstances where the geospatial products and services may only be a component solution of a more complex segment.
- Identify existing industry, non-government, or government organizations that may provide representation to the stakeholder community.
- Review the list of significant geospatial data themes and data sets within the purview of the Geospatial Platform portfolio.
- Determine security or use restriction that impact segment scope.
- Identify existing workgroup or subcommittees in the FGDC with domain expertise in this geospatial segment.

Resources:

Developing Effective Placed-Based Policies for the FY 2012 Budget
http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-21.pdf

Department of the Interior Trails Geospatial Solution Architecture Plan
http://www.nps.gov/gis/egim/library/2009_09_DOI_Trails_Geospatial_Solution_Architecture_v1.pdf

Executive Order 12906 – Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure
http://www.archives.gov/federal-register/executive-orders/pdf/12906.pdf

Executive Order 13286 – Amendment of Executive Orders including 12906
http://edocket.access.gpo.gov/2003/pdf/03-5343.pdf

Federal Geographic Data Committee Working Groups and Subcommittees
http://www.fgdc.gov/participation/working-groups-subcommittees

Geo-enabling Business Processes, Chapter 4, Federal Enterprise Architecture Geospatial Profile
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

Geospatial Science Segment Architecture, U.S. Department of Energy
http://www.cio.energy.gov/documents/DOE_Geospatial_Segment_Architecture.pdf

Geospatial Line of Business Data Call Analysis Report (List of proposed data themes)
http://www.fgdc.gov/geospatial-lob/geospatial-lob-data-call-analysis-071406.pdf

Geospatial Profile of the Federal Enterprise Architecture
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

Information Technology Capital Planning and Investment Control Process
http://ocio.os.doc.gov/ITPolicyandPrograms/Capital_Planning/dev01_003722

Modernization Roadmap for the Geospatial Platform
http://www.geoplatform.gov/

OMB Circular No. A-16 Revised – Coordination of Geographic Information and Related Spatial Data Activities
http://www.whitehouse.gov/omb/circulars_a016_rev

OMB Circular A-16 Supplemental Guidance
http://www.fgdc.gov/policyandplanning/A-16-supplemental-guidance-endorsed-dec08.pdf

OMB Circular No. A-119 - Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities
http://www.whitehouse.gov/omb/circulars_a119/

OMB Circular No. A-130 Management of Federal Information Resources
http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a130/a130trans4.pdf

---

Activity 2.2: Identify and prioritize strategic improvement opportunities.

Core outcomes: Performance gap analysis, strengths, weaknesses, opportunities and threats (SWOT) analysis.

Recommendations:

- Identify gap criteria, such as business process and information system performance, data sharing methods and standards, cost efficiencies, architecture adaptability and redundancy in data and technical architecture solutions.
- Review stakeholders current use of location products, and the community practices and/or standards they follow. Review and incorporate relevant standards identified for common use in the Geospatial Profile, including FGDC and FGDC-endorsed external standards.

- Examine opportunities for consolidation of infrastructure, products or administrative costs by the alteration or creation of a geospatial segment.
- Evaluate the quality, resolution, timeliness and content of the location data to see if it meets, or exceeds the business process requirements.
- Determine if existing geospatial data products or services can be re-used or adapted for use prior to acquisition of new data.
- Analyze existing lifecycle management frameworks to see if they are adequate for the proposed data products.
- Assess the capacity of human capital available to the segment.
- Determine if investment metrics exist that specifically identify geospatial resources.
- Identify all dependencies on existing products or services external to the segment that pose a measureable risk for success.
- Look for opportunities to leverage the existing Geospatial Platform architecture. Review the Technical Reference model and general geospatial segment architecture to assure alignment.
- Determine if the utilization of location content will engender a privacy risk.
- Consider opportunities to invest in more flexible deployment options to meet unforeseen stakeholder demand.

Resources:

Federal Geographic Data Committee endorsed standards
http://www.fgdc.gov/standards/projects/FGDC-standards-projects/fgdc-endorsed-standards

Geospatial Profile of the Federal Enterprise Architecture – Annex on Technical Reference Model
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns
http://www.fgdc.gov/policyandplanning/Access%20Guidelines.pdf

Modernization Roadmap for the Geospatial Platform
http://www.geoplatform.gov/

Segment scope outcomes from Step 1

Activity 2.3: Define agency geospatial segment strategic intent.

Core outcomes: Performance goals and objectives, performance scorecard.

Recommendations:

- Determine if the location value associated with the product or service is the primary element that enables the synthesis or result sought for the segment business processes.
- Define indicators to measure the effectiveness of location values in meeting mission or business processes.

- Define customer results measures, such as customer benefit, service coverage, timeliness and responsiveness, service quality and service accessibility.
- Utilize process measures, such as financial, productivity, cycle time and timeliness, security and privacy and management and innovation.
- Define function and capacity indicators for technical architecture elements, such as hardware, application software and service interfaces.
- Consider the role of locational accuracy, resolution and timeliness when developing customer satisfaction indicators for data products.
- Consider the total geographic area served, or other location elements as indicators for partial or overall segment performance.
- Consider the deep integration or coupling of geospatial products and services within mission services when trying to identify a representative maturity model.
- Identify other segments and business owners that may be impacted by possible changes to location products or services in this segment.
- Consider lifecycle management complexity and value chain analysis when developing process improvement indicators.
- Determine any restrictions associated with a new geospatial data product or service generated by this segment that would limit its re-use.
- Identify opportunities to use service level agreements for segment performance planning.

Resources:

Stakeholder needs assessments

Agency strategic plans – see resources in Step 1

Agency geospatial modernization plans – see resources in Step 1

Information Technology Investment Management – A Framework for Assessing and Improving Process Maturity
http://www.gao.gov/new.items/d04394g.pdf

Activity 2.4: Validate and communicate the scope and strategic intent.

Core outcomes: None.

Step 3: Define Business and Information Requirements

- **Activity 3.1:** Determine current business and information environment associated with strategic improvement opportunities.
- **Activity 3.2:** Determine business and information improvement opportunities.
- **Activity 3.3:** Define target business and data architecture.
- **Activity 3.4:** Validate and communicate target business and data architecture.

Activity 3.1: Determine current business and information environment associated with strategic improvement opportunities.

Core outcomes: As-is business function model.

Recommendations:

- Establish well-defined business processes (value chains) for the geospatial segment.
- Clearly identify how the value chains of the business functions and geospatial segment integrate.
- Examine exhibit 300 information to determine portfolio characteristics.
- Decompose the business processes sufficiently to analyze them in the context of geospatial functions, inputs and outputs and their role in strategic improvement.
- Define the service sector(s) supported by the segment.
- Evaluate use case(s) necessary for all business processes of the segment.
- Identify and confirm the authoritative source for the geospatial data product used in the segment.
- Identify the geospatial data for the segment as nationally significant, administrative and operational or as other geospatial data using definitions in the FEA Geospatial Profile.
- Identify criteria for data replacement, modification or enhancement.
- Identify the architecture used to spatially-enable the data storage environment(s).
- Identify the feature models, taxonomies, structures and formats for existing data products.
- Identify current exchange schema(s) used for data sharing services.
- Identify messaging protocols and query interfaces used in the data sharing processes.
- Identify repository architectures and implementations utilized by the segment.
- Determine the preferred mode(s) of delivery for the business process and the geospatial segment.

Resources:

Challenges in FEMA's Flood Map Modernization Program

https://www.dhs.gov/xoig/assets/mgmtrpts/OIG_05-44_Sep05.pdf

Geospatial Line of Business Common Solutions and Target Architecture
http://www.fgdc.gov/geospatial-lob/CSTA-redacted-march2007.pdf

Geospatial Information - Better Coordination and Oversight Could Help Reduce Duplicative Investments
http://www.gao.gov/new.items/d04824t.pdf

Geographic Information Systems – Challenges to Effective Data Sharing
http://www.gao.gov/new.items/d03874t.pdf

Geospatial Information and Geographic Information Systems (GIS): Current Issues and Future Challenges
http://www.fas.org/sgp/crs/misc/R40625.pdf

Geospatial Profile of the Federal Enterprise Architecture
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

The Business Reference Model - FEA Consolidated Reference Model Documentation, OMB
http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_CRM_v23_Final_Oct_2007_Revised.pdf

The Data Reference Model – OMB
http://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/DRM_2_0_Final.pdf

---

Activity 3.2: Determine business and information improvement opportunities.

Core outcomes: None.

Recommendations:

- Establish criteria to evaluate, prioritize and select improvements.
- Analyze customer, process and data architecture performance metrics for deficiencies.
- Identify business process improvements that can be directly correlated to modifications or enhancements to the spatial data architecture.
- Utilize the Enterprise Architecture Assessment Framework v3.1.
- Register nationally significant geospatial data products through the Geospatial Platform and evaluate opportunities for improvements by using the Geospatial Platform shared infrastructure.
- Evaluate license or copyright constraints from the aggregation of or derivation of by-products within the segment.

Resources:

Extended Geospatial Elements, Business Reference Model, view Appendix B below

Extended Geospatial Elements, Data Reference Model, view Appendix B below

Improving Agency Performance Using Information and Information Technology (Enterprise Architecture Assessment Framework v3.1)
http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/OMB_EA_Assessment_Framework_v3_1_June_2009.pdf

Revision Summary Document for the EA Assessment Framework (EAAF) Version 3.1

http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/Revision_Summary_OMB_EAAF_v31_June_2009.pdf

---

Activity 3.3: Define target business and data architecture.

Core outcomes: Target, business function model, conceptual data model, information flow diagrams, data stewardship assignments.

Recommendations:

- Identify data architecture changes required to meet business process enhancements.
- Define discovery, access, delivery and brokering services for nationally significant geospatial data.
- Define architecture for location enumeration, such as absolute coordinates, place name, address, FIPS code, Public Land Survey System, U.S. National Grid, other.
- Identify optimal authoritative and trusted geospatial data sources.
- Define criteria for data replacement, modification or enhancement.
- Define architecture used to spatially-enable the data storage environment(s).
- Utilize feature models, taxonomies, structures and formats endorsed by the FGDC, ANSI, and OGC.
- Utilize the CSDGM, ISO/TC 19115 and ISO 19139 encoding specifications.
- Utilize exchange schema(s) endorsed by the FGDC, ANSI, and OGC.
- Utilize messaging protocols and interfaces endorsed by the FGDC, ANSI and OGC.
- Utilize repository architectures that are part of the Geospatial Platform (GOS, Data.gov and the National Map).
- Define mode(s) of delivery endorsed by the Geospatial Platform.
- Evaluate pre-defined architectures associated with Enterprise License Agreements (ELA) or SmartBuy solutions.

Resources:

Common Solutions and Target Architecture, Geospatial Line of Business
http://www.fgdc.gov/geospatial-lob/CSTA-redacted-march2007.pdf

Department of Homeland Security Geospatial Data Model
http://www.fgdc.gov/participation/working-groups-subcommittees/hswg/dhs-gdm/index_html

Geographic Information Framework Data Standard, FGDC
http://www.fgdc.gov/standards/standards_publications/index_html

Standards Guide – ISO/TC 211 Geographic Information / Geomatics, 2009-06-01
http://www.isotc211.org/Outreach/ISO_TC%20_211_Standards_Guide.pdf

Improving Public Access to and Dissemination of Government Information and Using the Federal Enterprise Architecture Data Reference Model

http://www.whitehouse.gov/sites/default/files/omb/assets/omb/memoranda/fy2006/m06-02.pdf

North American Profile of ISO 19115:2003 Geographic Information Metadata
http://www.fgdc.gov/nap/metadata

OpenGIS Geography Markup Language Encoding Standard (and derived models)
http://www.opengeospatial.org/standards/gml

OpenGIS KML
http://www.opengeospatial.org/standards/kml

OpenGIS Web Mapping, Feature, Coverage, Sensor, and Catalog services
http://www.opengeospatial.org/standards

The Data Reference Model – OMB
http://www.whitehouse.gov/sites/default/files/omb/assets/egov_docs/DRM_2_0_Final.pdf

The Technical Reference Model - FEA Consolidated Reference Model Documentation
http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_CRM_v23_Final_Oct_2007_Revised.pdf

---

Activity 3.4: Validate and communicate target business and data architecture.

Core outcomes: None.

Step 4: Define the Conceptual Solution Architecture

- **Activity 4.1:** Assess systems and technology environment for alignment with performance, business and information requirements.
- **Activity 4.2:** Define the target conceptual solution architecture.
- **Activity 4.3:** Identify and analyze system and service transition dependencies.
- **Activity 4.4:** Validate and communicate the conceptual solution architecture.

Activity 4.1: Assess systems and technology environment for alignment with performance, business and information requirements.

Core outcomes: As-is conceptual solution architecture.

Recommendations:

- Identify existing system(s), existing and total capacity for throughput, functionality, security and other factors impacting response to business demands.
- Define scoring or ranking criteria for capability of systems and services to meet business process requirements.
- Identify metrics that discern system and service capabilities unique to geospatial capabilities.
- Determine maturity levels for the geospatial data and service capabilities.
- Identify other Federal segments with similar systems and technical architectures for re-use or consolidation opportunities.
- Analyze system ability to scale out or scale up beyond the target solutions.
- Identify system and service risks, such as interdependencies, systems lifespan and security and privacy obligations.
- Identify and score the ability of service interfaces to support business processes.
- Identify and rank consistency and compatibility of service interface types across the segment.
- Identify systems cost in exhibit 300 and exhibit 53 documents.
- Define total cost to provide, support and manage data, systems and services in the segment.

Resources:

Cost Savings Achieved Through E-Government and Line of Business Initiatives
http://www.whitehouse.gov/sites/default/files/omb/assets/omb/memoranda/fy2006/m06-22.pdf

Geospatial Standards and Extended TRM, Appendix D, Geospatial Profile of the Federal Enterprise Architecture
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

Standards Guide – ISO/TC 211 Geographic Information / Geomatics, 2009-06-01
http://www.isotc211.org/Outreach/ISO_TC%20_211_Standards_Guide.pdf

Pending list of endorsed external standards by FGDC

Activity 4.2: Define the target conceptual solution architecture.

Core outcomes: Target, conceptual solution architecture, service component architecture, technical architecture and re-use summary.

Recommendations:

- Define system and service elements for the target conceptual solution.
- Review available resources for re-use in the Federal Transition Framework (FTF).
- Review available shared infrastructure of the Geospatial Platform and Platform Network.
- Review availability of COTS, SmartBuy, and ELA solutions for the segment.
- Identify opportunities for system and service re-use from members of the Geospatial Platform Partner Network.
- Confirm that technical, service and information standards are aligned w/strategic goals.
- Determine service interface, security requirements, information, and maturity level requirements to each business process.
- Select existing system and services elements that may be included in the target solution.
- Develop target system and interface diagrams.
- Develop service component models.
- Identify new service transports, interfaces and systems components required.
- Identify existing Geospatial Platform system and service standards that can be applied to meet or support agency requirements.
- Assure that geospatial data and service resources are properly registered with the Geospatial Platform through the Data.gov and Geodata.gov catalog capabilities.

Resources:

Common Solutions and Target Architecture, Geospatial Line of Business
http://www.fgdc.gov/geospatial-lob/CSTA-redacted-march2007.pdf

Federal Transition Framework Catalog
http://www.whitehouse.gov/omb/e-gov/ftf/

Geospatial Service Components, Appendix C, Geospatial Profile of the Federal Enterprise Architecture
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

Geospatial Standards and Extended TRM, Appendix D, Geospatial Profile of the Federal Enterprise Architecture
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

Standards Guide – ISO/TC 211 Geographic Information / Geomatics, 2009-06-01

http://www.isotc211.org/Outreach/ISO_TC%20_211_Standards_Guide.pdf

OpenGIS Web Mapping, Feature, Coverage, Sensor, and Catalog services
http://www.opengeospatial.org/standards

U.S. General Services Administration SmartBUY Program Overview
http://www.gsa.gov/portal/content/105119

The Technology Reference Model - FEA Consolidated Reference Model Documentation, OMB
http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_CRM_v23_Final_Oct_2007_Revised.pdf

USDA Geospatial Segment Conceptual Target Architecture
http://www.ocio.usda.gov/geospatial/doc/Geospatial_Segment_Compilation_v2.pdf

Voluntary Consensus Standards Endorsed by FGDC (in review), view Appendix C below.

Activity 4.3: Identify and analyze system and service transition dependencies.

Core outcomes: Sequenced milestones.

Recommendations:

- Identify alternatives for transition from as-is to target state.
- Identify alternatives with a phase-in approach.
- Determine transition risks such as budget cycles and coincident inter-related system conversions.
- Evaluate other risks such as planned upgrades and deprecations by vendors and other suppliers to the segment.
- Evaluate remote service provider (cloud services) availability for solutions certified by U.S. General Services Administration (GSA); for example, software-as-a-service (SaaS), infrastructure-as-a-service (IaaS) and platform-as-a-service (PaaS).
- Determine effects, if any, of transition alternatives to the data architecture.

Resources:

Target conceptual, service and technical architecture output from Step 4.2

Integrated service component model output from Step 4.2

Re-use and data re-use summary output from Step 4.2
Geospatial Service Components, Appendix C, Geospatial Profile of the Federal Enterprise Architecture
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

Geospatial Standards and Extended TRM, Appendix D, Geospatial Profile of the Federal Enterprise Architecture
http://www.fgdc.gov/library/FEA_Geospatial_Profile_v_2.0_draft_5.7_20090306/view

The Technology Reference Model - FEA Consolidated Reference Model Documentation, OMB
http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_CRM_v23_Final_Oct_2007_Revised.pdf

The Service Reference Model - FEA Consolidated Reference Model Documentation, OMB
http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_CRM_v23_Final_Oct_2007_Revised.pdf

Value Measuring Methodology: How to Guide
http://www.cio.gov/Documents/ValueMeasuring_Methodology_HowToGuide_Oct_2002.pdf

Activity 4.4: Validate and communicate the conceptual solution architecture.

Core outcomes: None.

Step 5: Author the Modernization Blueprint

- **Activity 5.1:** Perform cost, value and risk analysis to develop implementation recommendations.
- **Activity 5.2:** Develop draft blueprint and sequence plan.
- **Activity 5.3:** Review and finalize the blueprint and sequencing plan.
- **Activity 5.4:** Brief core team and obtain approval.

Activity 5.1: Perform cost, value, and risk analysis to develop implementation recommendations.

Core outcomes: Recommendation sequencing diagram.

Recommendations:

- Develop a final business case using findings from the architecture process.
- Synthesize findings from Step 1 through Step 4 to support the analysis of transition options.
- Analyze each transition option for cost, value and risk.
- Develop "line of sight" or direct correlations between the solution architecture(s) and the geospatial segment business processes.
- Examine cost savings attributed to the use or development of standard geospatial data product or services.
- Determine value of expanded customer base as a result of the addition of or integration with geospatial capabilities.
- Determine if existing external data and services provide similar or complimentary functionality that can be re-used in the deployment of this segment.
- Determine if the alignments and cost savings incurred by using the Geospatial Platform resources and related resources such as GOS and Data.gov are being counted in the valuation process.

Resources:

Data.gov (data resource catalog)
http://www.data.gov/catalog/geodata

Geospatial One-Stop (data and service catalog)
http://www.geodata.gov

Information Technology Capital Planning and Investment Control Process
http://ocio.os.doc.gov/ITPolicyandPrograms/Capital_Planning/dev01_003722

Outputs from Step 1 through Step 4

The Performance Reference Model - FEA Consolidated Reference Model Documentation, OMB

http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_CRM_v23_Final_Oct_2007_Revised.pdf

Value Measuring Methodology: How to Guide
http://www.cio.gov/Documents/ValueMeasuring_Methodology_HowToGuide_Oct_2002.pdf

---

Activity 5.2: Develop draft blueprint and sequence plan.

Core outcomes: Strategic systems migration overview, modernization blueprint, segment mappings, transition plan milestones.

Recommendations:

- Develop a work breakdown structure with all high level inputs and outputs including those specific to geospatial resources.
- Develop a strategic system migration overview.
- Prioritize transition options.
- Define a final sequencing plan with schedule and all transition tasks associated with business processes, systems and services.
- Develop draft blueprint.

Resources:

Outputs from Step 1 through Step 4

Activity 5.3: Review and finalize the blueprint and sequencing plan.

Core outcomes: None.

Activity 5.4: Brief core team and obtain approval.

Core outcomes: None.

APPENDIX A: References

More information on the Federal Enterprise Architecture can be found at: http://www.whitehouse.gov/omb/e-gov/fea/.

More information on the Federal Segment Architecture Methodology can be found at: http://www.fsam.gov/.

More information on NOAA's Fire Weather Forecasting Web Service can be found at: http://www.spc.noaa.gov/exper/firecomp/sw/.

While FGDC has not officially adopted the North American Profile (NAP) of ISO 19115:2003 as a standard for metadata, it is the likely successor to CSDGM Version 2.0. More information about NAP can be found at: http://www.fgdc.gov/standards/projects/incits-l1-standards-projects/NAP-Metadata/napMetadataProfileV101.pdf/view.

More information on the Open Geospatial Consortiums Web Service Architecture description can be found at: http://www.w3.org/TR/ws-arch/.

More information on Office of Management and Budget (OMB) Circular A-16 Revised can be found at: http://www.whitehouse.gov/omb/circulars/a016/a016_rev.html.

National Geospatial Data Asset (NGDA) Themes are synonymous with OMB Circular A-16 Themes; an organizational construct under which multiple and related NGDA datasets are grouped logically and managed as a unit. A portfolio consists of a group of NGDA themes each of which is comprised of NGDA datasets. The datasets are selected from a larger and continually changing universe of geospatial datasets because they meet inclusion criteria. A dataset that has been designated as such by the FGDC Steering Committee and meets at least one of the following criteria: Supports mission goals of multiple Federal agencies; statutorily mandated; Supports Presidential priorities as expressed by Executive Order or by the OMB.

More information on the OMB Circular A-16 Supplemental Guidance Lexicon of Geospatial Terminology can be found at: http://www.fgdc.gov/policyandplanning/A16Draft/A16_SG_Lexicon.

More information on the OMB Circular A-119 Revised can be found at: http://www.whitehouse.gov/omb/circulars/a119/a119.html.

More information on the OMB Circular A-130 can be found at: http://www.whitehouse.gov/omb/circulars/a130/a130trans4.pdf.

More information on the E-Government Act of 2002, specifically Section 216 ("Common Protocols for Geographic Information Systems," Public Law 107-347) can be found at: http://www.gpoaccess.gov/serialset/cdocuments/sd107-18/pdf/pl107-347.pdf.

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.

More information on the 2005 – 2006 Federal Enterprise Architecture Program Management Office Action Plan can be found at: http://www.enterprise-architecture.info/Images/Documents/2005_FEA_PMO_Action_Plan_FINAL.pdf.

More information on Executive Order 12906 Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure can be found at: http://govinfo.library.unt.edu/npr/library/direct/orders/20fa.html.

More information on the Federal Geographic Data Committee can be found at: www.fgdc.gov.

More information on the E-Government Strategy can be found at: http://georgewbush-whitehouse.archives.gov/omb/egov/g-3-statement.html.

More information on Geospatial One Stop can be found at: http://www.geodata.gov.

More information on The National Map can be found at: http://nationalmap.gov/.

Orthorectification is the process of transforming raw imagery to an accurate orthogonal projection. Without orthorectification, scale is not constant in the image and accurate measurements of distance and direction cannot be made.

More information on the U.S. Board on Geographic Names can be found at: http://geonames.usgs.gov/.

More information on the International Organization for Standardization Technical Committee 21: Geographic information/Geomatics can be found at: http://www.isotc211.org/.

More information on the 32 different standards published by the International Organization for Standardization Technical Committee 21 can be found at: http://www.iso.org/iso/standards_development/technical_committees/list_of_iso_technical_committees.htm.

More information on the Open Geospatial Consortium, Inc can be found at: http://www.opengeospatial.org.

More information of the Open Government Initiative can be found at: http://www.whitehouse.gov/open.

More information on the FEA Practice Guidance can be found at: https://docs.google.com/viewer?url=http://www.whitehouse.gov/sites/default/files/omb/assets/fea_docs/FEA_Practice_Guidance_Nov_2007.pdf.

More information on the FICAM Roadmap and Implementation Guidance can be found at: https://docs.google.com/viewer?url=http://www.idmanagement.gov/documents/FICAM_Roadmap_Implementation_Guidance.pdf.

More information on the Federal Enterprise Architecture Records Management Profile can be found at: http://www.archives.gov/records-mgmt/policy/rm-profile.html.

More information on the Modernization Roadmap for the Geospatial Platform can be found at: http://www.geoplatform.gov/.

More information on the Geospatial Line of Business Common Solutions and Target Architecture can be found at: http://www.fgdc.gov/geospatial-lob/CSTA-redacted-march2007.pdf.

APPENDIX B: Reference Model Extensions for Geospatial Elements

Business Model Architectural Extensions	
E-Government Alignment: IEE Segment	
Trigger	
Part 1: A business function requires geospatial data	
Part 2: Infrastructure is required to store the data and make it available	
Part 3: Data and infrastructure require maintenance	
Actors: Program Manager, Data Steward, System Administrator	
Endpoints	
Geospatial data supports a business function	
Infrastructure is available to store and offer access to geospatial data Assets (infrastructure and data) are maintained to standards and upgraded as necessary	
Asset owners offer access and use of assets on a case by case basis	
Data Model Architectural Extensions	
Data Elements	
Identifier	
Location	
Context specific attributes	
Relate fields	
Topology	
Metadata	
Roles	
Data Repositories	
Agency spatial databases	
Agency server	
Agency management tools	
Agency integration tools – business intelligence	
Federal repositories – GOS, National Map	
Other agency repositories (A-16)	
Service Model Architectural Extensions	**Description**
Catalog service	Responds to client requests for geospatial resource metadata. Geospatial resources include maps and data from which maps may be derived, and ancillary products and services. Geospatial catalogs characterize and access resources using variable taxonomies and protocols.

Coordinate transformation service	The ability to transform geospatial data between different coordinate reference systems, datum, and units. Capabilities usually include map re-projection for visualization, and for permanent conversion.
Gazetteer service	A function to determine the geospatial coordinates for a place, given an address, place name, or identifier. This function accesses a database of geographic features and returns the location and descriptive information.
Gazetteer update service	An application to support browsing, data entry, transformation, integration and update of a gazetteer database. Supports adding, changing, and deleting gazetteer records. Assures that credentials are sufficient for change requests and that changes pass validation rules.
Geocode service	A capability to determine geospatial coordinates from an address, or determines address from geospatial coordinates (reverse geocode). A geocode service transforms a description of a feature location, such as a place name, street address or postal code, into a normalized description of the location which includes coordinates. A geocode service receives a description of a feature location as input and provides a normalized address with coordinates as output. The feature location descriptions are any terms, codes, or phrases that describe the features and that are well-known to the geocode service, such as a street addressing or postal coding scheme. Geocode services are important across the enterprises, as they enable enterprise users to exploit the geospatial context of a diversity of business data that contain location references, such as address, building name, and census tract. The geocode process is also valuable to fusing dissimilar data on the basis of variable geospatial characteristics.
Geospatial information broker	A component used to move geospatial data between systems. Involved in data sharing and collaboration operations. Involved in geospatial data roll-up/roll-down operations.
Geospatial data exchange and transformation service	The ability to import, export, manipulate, and convert geospatial data through standard data exchange and transformation services. Services to transform geospatial data schemas between disparate systems.
Geo-locate service	The capability to use GPS or other means to determine a geographic location for a fixed or mobile object . Mobile objects must be equipped with GPS, Radio Frequency ID, and/or other position determination technologies. Includes sensor data retrieval or other geographic monitoring services.
Geo-parser service	Geo-parsing refers to the capability to scan and parse a document, identifying key words and phrases that contain geospatial references. A geo-parser service uses: a reserved vocabulary (a dictionary of place names, a gazetteer or a directory of points of interest and a text source such as a newspaper article or white paper. The geo-parser returns all occurrences of the use (in the text source) of any term in the reserved

	vocabulary. Every parsed record establishes a geo-link (geospatial-aware hyperlink) between text terms and the geospatial location associated with the reserved word. That result is an annotated text document with geo-links.
GIS	An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, manipulating, visualizing, analyzing, and exploiting geospatial information. GIS's focus on producing and exploiting "digital maps" that convey geospatial information in graphical form. A technology used widely in government, education, and business. A general-purpose collection of tools for processing geospatial data. Normally consists of applications and geospatial data. May be configured as a desktop application or as a collection of client and server components.
GIS server	Geospatial processing services that support the generation, revision, management, processing, and output of geospatial data. Server-based GIS.
Image processing service	An image processing system service is an integrated system for collecting, storing, accessing, sharing, disseminating, integrating, manipulating, visualizing, analyzing, and otherwise exploiting geospatial imagery. It focuses on producing and exploiting digital orthoimagery that conveys geospatial information in raster image form.
Mapping client	An application to visualize and interact with geospatial data in map form. Provides tools to select base map and image data for viewing, layer control (features, locations, structures, routes, observations, and mobile-objects), set view window, display chosen view, coordinate transformation, measure and pinpoint, navigate through view with pan and zoom, etc. Optionally choose symbols, map display template or select previous views. Usually associated with one or more map servers.
Map publication service	A lightweight application for publishing maps. Able to automatically generate and publish maps of interest for inclusion in a plan, report, or other document, with select content and symbolization (map template; e.g., to produce a map for inclusion in a word or graphic document).
Model service	Able to determine and access the extent and nature of a geospatial model (e.g., toxic dispersion model—plume for a chemical or biological event in air or water). The model output is characterized by features. Toxic dispersion refers to the effects of introducing a chemical, radioactive, or biological agent into the atmosphere or a water supply at a point source. Simulation is employed to understand the effects of a toxic agent within its medium. The objective of the simulation is to ascertain contamination levels in a geospatial-temporal context, and thus, to understand the nature of toxic plumes, danger zones, warning zones, and related features, and to be able to view or analyze the output from a simulation run in conjunction

	with any other geospatial data, e.g., as plumes or danger/warning zones within a geospatial decision support tool. Also, the ability to determine and access weather, hydrographic, and other environmental parameters through environmental simulation. The simulation output is characterized by observations.
Navigation service	A service which determines routes between two or more points with enhanced navigation information. An important service used in location based services.
Sensor planning service	A service by which a client can determine sensor collection feasibility for a desired set of collection requests for one or more mobile sensors/platforms, or the client may submit collection requests directly to these sensors/platforms.
Topology service	The ability to detect topological errors (e.g., overshoots and undershoots of common linear and polygon features within a definable tolerance), automatically correct errors, if possible, and define topological relationships between connected/collocated linear, polygon, and point features.
Web Map Service	WMS is an OGC specification for serving geo-referenced map images over the Internet that are generated by a map server using data from a GIS database.
Web Feature Service	WFS is an OGC interface specification to access and manage geographical features across the Internet using platform-independent calls. Features act as the "source code" behind a map. The Extensible Markup Language implementation, Geography Markup Language, furnishes the default payload encoding; other transport formats are available. The GML Simple Features Profile offers a restricted version of GML and is intended to increase interoperability between WFS servers.
Data processing service	
Business services	
Technology Model Architectural Extensions	
Hardware and software	
Spatial database	
GIS server	
GIS software	
Web server	
Clients	
Interfaces	
API’s	
Standards	
CSDGM or ISO 19115 NAP	
Agency or community spatial standards (i.e. DoD	

SDSFIE)	
OGC WMS, WFS, GML	
Open business specifications	

Appendix C: Voluntary Consensus Standards

Standard Identifier	Standard Title
GeoTIFF Revision 1.0	GeoTIFF Revision 1.0.
HDF 5	Hierarchical Data Format V 5.0.
INCITS 145 - 1986 [R2007]	Codes for Identification of Hydrologic Units in the U.S. and the Caribbean (Outlying) Areas.
INCITS 31-2009	Information technology - Codes for the Identification of Counties and Equivalent Areas of the United States, Puerto Rico, and the Insular Areas.
INCITS 38-2009	Information technology - Codes for the Identification of the States and Equivalent Areas within the United States, Puerto Rico, and the Insular Areas.
INCITS 415 – 2006	Information technology - Homeland Security Mapping Standard - Point Symbology for Emergency Management.
INCITS 446-2008	Information technology - Identifying Attributes for Named Physical and Cultural Geographic Features (Except Roads and Highways) of the United States, Its Territories, Outlying Areas, and Freely Associated Areas, and the Waters of the Same to the Limit of the Twelve-Mile Statutory Zone.
INCITS 453 – 2009	Information technology - North American Profile of ISO 19115:2003 - Geographic information - Metadata (NAP - Metadata).
INCITS 454 - 2009	Information technology - Codes for the Identification of Metropolitan and Micropolitan Statistical Areas and Related Statistical Areas of the United States and Puerto Rico.
INCITS 455 – 2009	Information technology - Codes for the Identification of Congressional Districts and Equivalent Areas of the United States, Puerto Rico, and the Insular Areas.
INCITS/ISO 19107:2003[R2008]	Geographic Information - Spatial schema.
INCITS/ISO 19108:2002[R2008] ISO 19108:2002 w/ Cor 1:2006	Geographic information - Temporal schema w/Corrigendum 1.
INCITS/ISO 19110:2005 [R2010]	Geographic information - Methodology for Feature Cataloguing.
INCITS/ISO 19111:2007 [2007]	Geographic information - Spatial referencing by coordinates.
INCITS/ISO 19111-2:2007	Georgraphic information - Spatial referencing by coordinates - extension for parametric values.
INCITS/ISO 19112:2003 [2004]	Geographic information - Spatial referencing by geographic identifiers.
INCITS/ISO 19115:2003 [R2008] ISO 19115:2003 w/ ISO 19115 Cor. 1:2006	Geographic information - Metadata + Corrigendum 1.
INCITS/ISO 19115-2:2009 [2009]	Geographic information - Metadata - Part 2: Extensions for imagery and gridded data.
INCITS/ISO 19118:2005 [2006]	Geographic information – Encoding.
INCITS/ISO 19119:2005 [R2010]	Geographic information – Services.
INCITS/ISO 19119:2005/AM 1:2008 [2008]	Geographic information - Services - Amendment 1: Extensions of the service metadata model.
INCITS/ISO 19123:2005 [2006]	Geographic information - Schema for coverage geometry and functions.
INCITS/ISO 19132:2007 [2008]	Geographic information - Location Based Services - Reference model.
INCITS/ISO 19133:2005 [2006]	Geographic information - Location Based Services - Tracking and navigation.

INCITS/ISO 19134:2007 [2007]	Geographic information - Location Based Services - Multimodal routing and navigation.
INCITS/ISO 19135:2005 [2006]	Geographic information - Procedures for registration of geographical information items.
INCITS/ISO 19141:2008 [2008]	Geographic information - Schema for moving features.
ISO 19109:2005	Geographic information - Rules for application schema.
ISO 19127:2005	Geographic information - Geodetic codes and parameters.
ISO 19131:2007	Geographic information - Data product specifications + Amendment 1.
ISO 19136:2007	Geographic information - Geographic Markup Language.
ISO 19144-1:2009	Geographic information -- Classification Systems -- Part 1: Classification system structure.
ISO 3166	ISO 3166 - Codes for the Representation of Names Of Countries and their Subdivisions.
ISO 6709:2008/Corrigendum 1:2009	Standards representation of geographic point locations by coordinates w/Corrigendum 1.
ISO/IEC 13818-2:2000	MPEG 2 – video.
ISO/IEC 13818-3:1998	MPEG 2 – audio.
ISO/IEC 15444-1:2004 | ITU-T Rec. T.800	JPEG 2000.
ISO/IEC IS 10918-1 | ITU-T Recommendation T.81	JPEG.
ISO/TS 19103:2004	Geographic information - Conceptual schema language.
ISO/TS 19104:2008	Geographic information – Terminology.
ISO/TS 19138:2006	Geographic information -- Data quality measures.
ISO/TS 19139:2007	Geographic information -- Metadata -- XML schema implementation .
NetCDF	NetCDF (Network Common Data Form).
OGC 04-094; OGC 06-027r1	OpenGIS® Web Feature Service Implementation Specification, version 1.1.0 with Corrigendum 1.
OGC 04-095	OpenGIS® Filter Encoding Implementation Specification, version 1.1.
OGC 05-005; OGC 08-050	OpenGIS® Web Map Context (WMC) Documents Implementation Specification, Version 1.1.0 w/Corrigendum 1.
OGC 05-007r7; OGC 08-091r6	OpenGIS® Web Processing Service, Version: 1.0.0 w/ Corrigendum.
OGC 05-077r4	OpenGIS® Symbology Encoding Implementation Specification, version 1.1.0.
OGC 05-078r4	Styled Layer Descriptor profile of the Web Map Service Implementation Specification, version 1.1.0.
OGC 06-009r6	OpenGIS® Sensor Observation Service Interface Standard, version 1.0.0.
OGC 06-024r4	OpenGIS® Location Services: Tracking Service Interface Standard.
OGC 06-042	OpenGIS® Web Map Service Implementation Specification, Version 1.3.0.

OGC 07-000, OGC 07-122r2	OpenGIS® SensorML Encoding Standard v 1.0 w/Schema Corregendum 1 (1.01).
OGC 07-006r1; OGC 07-010	OpenGIS® Catalogue Service (CAT) Implementation Specification (2.0.2) + Corrigendum for OpenGIS Implementation Specification 07-006: Catalogue Services, Version 2.0.2.
OGC 07-045	OpenGIS® Catalogue Services Specification 2.0.2 - ISO Metadata Application Profile.
OGC 07-057r7	OpenGIS® Web Map Tile Service Implementation Standard, version 1.0.0.
OGC 07-067r5, 07-066r5	OpenGIS® Web Coverage Service (WCS) Implementation Standard, version 1.1.2 w/Corregindum 2.
OGC 07-074	OpenGIS® Location Services (OpenLS): Core Services, version 1.2.
OGC 07-134r2	OGC KML 2.2 – Abstract Test Suite (1.0.0).
OGC 07-147r2	OpenGIS® KML, version 2.2.0.
OGC 08-028r7	OpenGIS® Location Services (OpenLS): Part 6-Navigation Service.
OGC 06-024r4	OpenGIS® Location Services: Tracking Service Interface Standard.
OGC® 07-000	OpenGIS® Sensor Model Language (SensorML) Implementation Specification, version 1.0.0.
OGC® 07-014r3	OpenGIS® Sensor Planning Service Implementation Specification, version 1.0.0.
TIFF Revision 6.0	Tagged Image File Format (TIFF).
UML 2.2	Unified Model Language (UML) 2.2.

APPENDIX D: Acronyms

Acronym	Definition
3D	Three Dimensional
ANSI	American National Standards Institute
API	Application Programming Interfaces
COTS	Commercial Off-the-Shelf
CSDGM	Content Standard for Digital Geospatial Metadata
ELA	Enterprise License Agreement
FEA	Federal Enterprise Architecture
FGDC	Federal Geographic Data Committee
FSAM	Federal Segment Architecture Methodology
FTF	Federal Transition Framework
GAO	U.S. Government Accountability Office
Geospatial LoB	Geospatial Line of Business
GEOSS	Global Earth Observing System of Systems
GIO	Geographic Information Officer
GIS	Geographic Information Systems
GOS	Geospatial One Stop
GPS	Global Positing Systems
GSA	U.S. General Services Administration
IG	Inspector General
INCITS L1	International Committee on Information Technology Standards, Committee L1
IaaS	Infrastructure-as-a-Service
ISO	International Organization for Standardization
IT	Information Technology
LBS	Location-based services
LIDAR	Light Detection and Ranging
NGDA	National Geospatial Data Asset
NIEM	National Information Exchange Model
NOAA	National Oceanic Atmospheric Administration
NSDI	National Spatial Data Infrastructure
OGC	Open Geospatial Consortium
OGC	Open Geospatial Consortium
OMB	Office of Management and Budget

PaaS	Platform-as-a-Service
PMO	Program Management Office
SAOGI	Senior Agency Official for Geospatial Information
SaaS	Software-as-a-Service
SWOT	Strengths, Weaknesses, Opportunities and Threats Analysis
USGS	United States Geological Survey