# DRAFT

# Federal Enterprise Architecture
# Geospatial Profile
# Version 0.4

**IMPORTANT NOTE TO READERS:**

**This is a draft document provided primarily for those interested in our progress.**

**Please do not comment on this version.**

**We will be posting the 1.0 version in the first or second week of January.**



Architecture and Infrastructure Committee,

Federal Chief Information Officers Council

And

Federal Geographic Data Committee

December 23, 2005

# Executive Summary

A key factor of the Federal Enterprise Architecture (FEA) efforts is to ensure inter-organizational exploitation of information. By following the methodologies outlined in the FEA guidance, government organizations at all levels architect solutions that enable interoperability, providing improved services to citizens as outlined in the President's Management Agenda.

Geospatial data and capabilities are integral to virtually all federal, state, local, and tribal government activities. Yet, basic questions are difficult to answer:

- How do organizations identify and describe the geospatial data, capabilities, and needs within their enterprise architecture?
- How are these capabilities and needs more easily reflected and planned for within an organizations' Information Technology infrastructure?
- How do geospatial data and technologies enhance the business processes that are essential for mission fulfillment?

Through application of this Geospatial Profile in the design and execution of business practices, organizations can answer these questions, and improve information exchange across – and beyond – the federal government in terms of viewing problems and analyzing information based on the location of entities (or events) of interest.

Although linked to key elements of the FEA, the scope and relevance of the Geospatial Profile is applicable to all types of organization that are interested in developing a consistent geospatial capability within their business activities – inside and outside of the federal government. By embracing the multi-jurisdictional and pervasive nature of geospatial capabilities, this Profile is intended to promote broad use of common geospatial information and services among governmental partners at all levels of government.

The Geospatial Profile has been organized to first introduce basic geospatial principles, provide context and scope, and identify the intended audience. Following chapters provide more in-depth guidance on geospatial considerations in each of the reference models (Performance, Business, Data, Service, and Technical). Supplemental annexes were then added for extended background and reference materials, as well as explanations of terminology and valuable reference. To further illuminate and enforce the various concepts, an application scenario focusing on the Disaster Preparedness and Planning and Emergency Response sub-functions is presented across, and in the context of, all reference models.

## Geospatial View to the Reference Models

The FEA consists of a set of interrelated "reference models" designed to facilitate cross-agency analysis and the identification of duplicative investments, gaps and opportunities for collaboration within and across agencies. Collectively, the reference models comprise a framework for describing important elements of the FEA in a common and consistent way.

Through the use of this common framework and vocabulary, IT portfolios can be better managed and leveraged across the federal government. This Profile provides a geospatial perspective to each of the five FEA reference models.

**Performance Reference Model**— the discussion focuses on setting targets for action and measuring the degree of transformation achieved.

Of all the FEA reference models, the PRM is of particular use to the development of fledgling geospatial programs across government because it provides a structure for analyzing means and ends. Unlike the other FEA- profiled functions (records management and security), which are derived demands of other activities, geospatial programs are mostly elective and opportunity-driven. The PRM provides a tool for focusing scarce geospatial resources most effectively, and for communicating to outsiders what benefits the geospatial program will provide, and how.

**Business Reference Model**—the discussion centers around a process and methodology to help enterprise architects identify and describe the geospatial nature of their business activities.

The value of place or location-based analysis is often overlooked when modeling business processes, because enterprise architects and program managers typically think of geospatial data only in the context of a map or a remotely sensed image created with GIS applications. The coupling of geospatial data, services and technology with conventional data and technologies are often one of the most significant enablers of improved decision making within business operations. It increases performance of key mission requirements across all levels of governments. This section is provided to help program managers and enterprise architects gain a better understanding of how they can incorporate geospatial data, services and technology into their business processes.

**Data Reference Model**—the discussion provides a geospatial view of the elements of the FEA DRM and the mechanisms used by the geospatial community to implement the FEA DRM in practice.

The Geospatial Data Reference Model addresses all the components, interfaces and processes for implementing and managing an integrated, cohesive geospatial data policy. These components include a data documentation, development and adoption of data sharing standards and protocols, as well as the conceptual and logical design and modeling of the geospatial aspects of your business data. This section provides guidance to enterprise architecture authors regarding how to describe geospatial data and metadata, as well as explanations of how existing geospatial investments align with the FEA DRM.

**Service Component Reference Model**—the discussion centers on providing an extension of the FEA SRM to include geospatial specializations of the Service Components.

The Federal Enterprise Architecture Program Management Office has developed a Service Component Reference Model as a baseline for categorizing and aligning federal business applications into common, reusable Service Components, which are categorized into appropriate service domains and service types. In line with this goal, the Geospatial SRM serves to build upon and extend the FEA SRM by defining, classifying, categorizing and recommending common, reusable geospatial "building blocks" – Geospatial Service Components – for reuse in government computing environments. This section also provides guidance to agencies concerning Geospatial SRM implementation and use, aligning with and leveraging existing federal guidance, FEA PMO and Federal CIO Council recommendations, and harmonizing with other significant Federal interoperability and resource sharing initiatives, such as the National Information Exchange Model.

**Technical Reference Model**—the discussion provides an extension of the FEA TRM to include geospatial technology standards.

The Geospatial TRM establishes the basic guidance necessary to help ensure that proposed IT solutions which have or desire a geospatial location component are in compliance with industry standards, and therefore are likely to integrate efficiently into a multi-agency information sharing and processing environment. Specifically, the Geospatial TRM is intended to describe elements of proposed solutions using a standard vocabulary and categorization scheme. This allows for comparison of those elements, facilitating the identification of overlaps and gaps, and opportunities for sharing technical solutions and standards.

**Organizational Maturity**—provides a proposed framework for measuring the maturity of an organization. The model measures maturity with respect to the implementation of the guidance within this profile and other factors assembled for that purpose.

## Conclusion

The Executive Office of the President will use the geospatial profile of the FEA to ensure that all organizations will ***architect, invest, and implement*** geospatial capabilities in a coordinated way that works for Federal, State, and Local governments, as well as other data sharing partners. Many organizations are looking for help in guiding their information technologists through the world of geospatial tools and capabilities. The Geospatial Profile will provide a much needed blueprint for them to follow in helping them invest and build together, ensuring data sharing and interoperability.

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# Acknowledgements

The acknowledgements will be forthcoming in the 1.0 version of the Geospatial Profile.

# Future Work

The following is a partial listing of the suggested future work required to "complete" the Geospatial Profile.

1. Add the three business functions mentioned in section 3.2 to Chapter 4 and mention them in the Introduction. This is targeted for version 1.0 (Editor)

2. Provide the Acknowledgements. This is targeted for version 1.0. (Editor/Doug Nebert/Brenda Smith)

3. Chapter 5: Refine the DRM chapter to reflect the content of DRM 2.0. This is targeted for a version in the post-1.0 time frame. (DRM team/Editor)

4. Chapter 7: Provide technologies as noted at the beginning of the Geospatial TRM into the TRM. Recommend starting with the Technologies listed in the Geospatial Business Language (Appendix F). This is targeted for a version in the post-1.0 time frame. (TRM team/Editor).

5. Chapter 8: Examine the levels described in the EAAF 2.0 and further work on the GIMM levels to improve their consistency and then adjust the corresponding level descriptions within the GIMM categories. This is targeted for version 1.0 (BRM-PRM team/Editor)

# 1 Introduction to the Geospatial Profile

In the context of the Federal Enterprise Architecture, the development of a "Profile" for a specific application area is intended to provide supplemental information regarding certain activities that are common to most lines of business and organizations. The concept of a Profile is applicable to the construction of any enterprise architecture at any level of organization; it applies equally well to non-federal environments. In the federal domain, the Geospatial Profile joins the Security and Privacy[1] and Records Management Profiles in providing cross-government guidance intended to promote common, consistent enterprise architecture practice that results in improved business performance (See Figure 1).

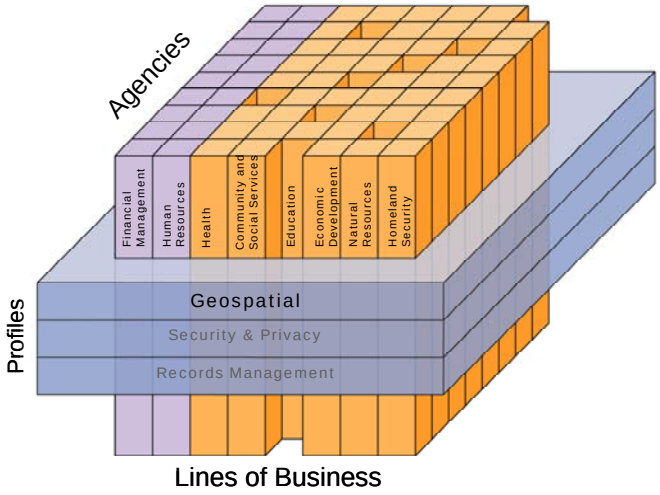


**Figure 1: Enterprise Architecture Profile concept**

The Federal Enterprise Architecture (FEA) is promoted by the Office of Management and Budget as a methodology to assist in the consistent modeling, description, and execution of business practices in all agencies. The FEA is based on a common set of reference models in use by the public and private sector, that collectively define the operations of an organization in support of its mission. For further information on the FEA, consult Appendix C of this Profile.

## 1.1 Context of Problem

The following challenges are a result of ineffective use of geospatial information and services to support government business activities:

- Organizations are frequently limited in interoperability and their ability to share information and to collaborate with other government agencies or organizations particularly in times of emergencies or where rapid decisions are needed for business purposes
- Providers and consumers of geospatial data and services do not share semantics and functional capabilities, limiting interoperability
- Organizations often do not take advantage of information resources that are available through existing spatial data infrastructure services and networks, and therefore unknowingly create redundant capabilities
- Organizations do not know what other geospatial information exists

[1] Available as http://www.cio.gov/documents/FEA_Security_Profile_Phase_I_Final_07-29-2004.pdf

- Spatial data infrastructure services and networks may exist but are not adequately described for discovery or to permit the assessment of quality for re-use
- Organizations often do not use the best geospatial information resource because data is in too many places, too many possible sources exist, source are of unknown "pedigree", sources not properly documented, and sources not easily searched
- Geospatial information and services are not planned, acquired, managed, and shared consistently within and across organizations
- Geospatial data and services are not readily available to users and applications over the Web or via service-oriented architectures

Given the above challenges and the recognition that geospatial data and capabilities are integral to virtually all federal, state, local, and tribal government activities, the Federal Enterprise Architecture (FEA) Program Management Office (PMO), the Federal Chief Information Officers Council's Architecture and Infrastructure Committee (AIC), the Federal Geographic Data Committee (FGDC) and others expressed a need for further guidance.

## 1.2 Objectives, Purpose, and Scope

The Geospatial Profile intends to inform and help align governmental architecture and geospatial community practices by fulfilling the following objectives:

1) Support the systematic description and sharing of government geospatial resources (e.g. data models, service interface definitions, business processes, etc.) and concepts that relate to the FEA Reference Models[2,3].

2) Provide guidance for identifying geospatial capabilities within agency Performance, Business, Data, Service Component (Application), and Technology Architectures.

3) Provide examples of applying the Geospatial Profile's guidance.

The purpose of this FEA Geospatial Profile is to provide guidance to government organizations to help them identify and describe the role of geospatial data, services, and related capabilities in the design of their enterprise architecture. Once these geospatial characteristics have been realized and needs addressed they will become part of the business processes that are essential for improved mission performance and will be reflected in their Information Technology infrastructure. Further, the inclusion of geospatial functionality in enterprise architectures across government may imcrease opportunities for data sharing and the adoption and use of interoperable, standards-based geospatial tools and technologies for many lines of business. In this regard, the profile supports the development and use of common and shared geospatial resources within the National Spatial Data Infrastructure (NSDI), described in Section 2 of this document.

This document does not provide direct implementation guidance or address the development of systems or solution architectures. It also does not define prescriptive government policy or compliance requirements. The intention is to inform architects as to the pervasiveness and value of a

[2] Available as http://www.whitehouse.gov/omb/egov/documents/CRM.PDF

[3] For example, the geospatial integration performance measures and the geospatial integration maturity model (see Geospatial PRM in chapter 3 and the GIMM in Chapter 8), the geospatial business language (see Geospatial BRM in Chapter 4), geospatial data (see Geospatial DRM in Chapter 5), geospatial service components (see Geospatial SRM in Chapter 6), and technology standards (see Geospatial TRM in Chapter 7).

systematic approach to recognizing and incorporating geospatial activities in modeling the government enterprise.

## 1.3 Audience

The Geospatial Profile is primarily intended for the following individuals

- those responsible for developing enterprise architectures and managing enterprise architecture programs, and ensuring that geospatial requirements are incorporated within enterprise architectures (Enterprise of Chief Architects).
- those responsible for the overall coordination of an organization's IT planning, development, and management activities to support business needs. This may include Chief Information Officer leadership and staff and, in some agencies, Geospatial Information Officers (GIO) -- responsible for planning and managing an organization's geospatial activities, investments, and assets.

Given the above primary audience, the profile should also be useful business managers, discipline practitioners, data stewards, portfolio managers, capital planners, solutions providers, and geospatial vendors and consultants.

In particular, the Geospatial Profile portrays the need to interconnect the various views of architecture, including the business and performance-driven perspective and the IT perspective (see chapters 3-7 for more information on these topics).

## 1.4 Legislative context

According to the Office of Management and Budget's (OMB) FY 2003 Report to Congress on Implementation of The E-Government Act (March 8, 2004)[4]:

> *Although a wealth of geospatial information exists, it is often difficult to locate, access, share, and integrate in a timely and efficient manner. Many Federal, state, and local agencies collect and use geospatial data in different formats and standards based on their requirements. This results in wasteful spending, redundant data collection, and can hinder the ability of federal, state, and local governments to effectively and efficiently provide information and services to each other, citizens, and business.*

In addition,

The OMB FEA Program Management Office's (PMO) 2005 - 2006 Federal Enterprise Architecture Action Plan[5] (March 2005) includes a strategic initiative, Create a Geospatial Profile, which is described as follows:

> […] the ability of Federal agencies to create and appropriately manage geospatial information has become increasingly important. The purpose of the President's Geospatial One-Stop Initiative is to provide Federal, State, local and tribal agencies with a single point of access to map-related data enabling consolidation of redundant data. The goal is to improve the ability of the public and government to use geospatial information to support the business of government and improve decision-making.

[4] Available as http://www.whitehouse.gov/omb/egov/fy03_egov_rpt_to_congress.pdf

[5] Available as http://www.whitehouse.gov/omb/egov/documents/2005_FEA_PMO_Action_Plan_FINAL.pdf

OMB has issued guidance (i.e., OMB Circulars A-16[6] and A-11[7]) providing direction for Federal agencies producing, maintaining or using spatial data either directly or indirectly in the fulfillment of their mission. This direction includes general responsibilities for preparing, maintaining, publishing and implementing a strategy for advancing spatial data activities in support of the National Spatial Data Infrastructure (NSDI) strategy. It instructs agencies to use Federal Geographic Data Committee (FGDC) data standards. […]

[…] The purpose of this profile is to provide a consistent framework that can be applied within and across agencies to identify the geospatial implications across lines of business. […]

## 1.5 Document Organization and Usage

This document is a companion to the Federal Enterprise Architecture reference model documents (See Introduction to FEA on page 21). The main body of this document describes the geospatial characteristics that may be present in each of the enterprise architecture reference models. The remainder of this document is organized into the following chapters and appendices:

- Introduction to Geospatial Concepts—defines the ubiquity of geospatial information, provides a background on geospatial information, usages, and services, and introduces the NSDI. This section provides an orientation to geospatial capabilities for those not familiar with the discipline.
- Performance—introduces some geospatial performance measures as they relate to the FEA PRM. This section also introduces a Geospatial Integration Maturity Model as a methodology for agencies to self-assess the maturity of their organization with respect to geospatial capability.
- Business—introduces the relationship of geospatial capability to each of the FEA BRM lines of business and provides example geospatial business processes for each. This section defines a business architecture methodology to support the integration of business-driven geospatial capabilities into agency architecture.
- Data—presents the common geospatial data standards that relate to the FEA DRM and its focus areas of Data Description, Data Context, and Data Sharing. This section interprets Data Reference Model guidance in terms of current practices in the geospatial community.
- Services—provides an extension of the FEA SRM to include many geospatial service components and provides some methodology to guide the inclusion of geospatial service components in agency service (application) architectures. This section extends the Service Component Reference model taxonomies to reference common geospatial capabilities.
- Technology—defines an extension of the FEA TRM to include many geospatial technologies and standards. This section provides a list of current geospatial standards and specifications that are relevant in the development of an agency architecture.

[6] Available as http://www.whitehouse.gov/omb/circulars/a016/a016_rev.html

[7] Available as http://www.whitehouse.gov/omb/circulars/a11/current_year/a_11_2005.pdf

- Organizational Maturity—provides a proposed framework for measuring the maturity of an organization. The model measures maturity with respect to the implementation of the guidance within this profile and other factors assembled for that purpose.
- Appendix A: References—provides a listing of the references used in the document.
- Appendix B: Glossary—provides a glossary of terms used in the document.
- Appendix C: FEA Overview—introduces the FEA reference models and describes the relationship of the Geospatial Profile to the FEA reference models.
- Appendix D: Geospatial Profile Use Case—provides the detail of the use case used in the examples found throughout the document.
- Appendix E: Geospatial Activity Examples for FEA BRM Lines of Business—provides the geospatial business processes described in the Business chapter.
- Appendix F: Geospatial Business Language—details a set of business terms (of a geospatial nature) that are used in the Business Architecture methodology described in the Business chapter.
- Appendix G: Geospatial Service Components—presents the actual geospatial service components described in the Services chapter.
- Appendix H: Geospatial Standards —provides the list of standards described in the Data and Technology chapters.
- Appendix I: Acronym List—provides a list of acronyms used in the document.

# 2 Introduction to Geospatial Concepts

## 2.1 Geospatial Is Everywhere

The intrinsic value of geospatial location is obvious to many people when it is used to guide driving and walking, buy and sell a house, respond to an emergency, or understand the world around us. The presence and value of geospatial location is not as obvious when it is embedded within text, statistics, charts, records, or other data in a database. Examples of these embedded geospatial data are street addresses, highway names, latitude-longitude coordinates, and highway mile markers. The key to success is to make sure that the value of using these data exceeds the cost to have gotten an answer. The FEA and this document go hand in hand to guide government agencies in doing just that – maximizing the value of using geospatial information and at the same time minimizing the costs. Geospatial data, when processed, often with other data, such as the name of an individual, a particular vehicle, the name of a hurricane, or the victims of an automobile accident, become geospatial information[8].

Geospatial location is ubiquitous in our everyday lives. People very often refer to information in geospatial context. We speak of where we live, where we are as we are driving, where a hurricane is and where it is going, where an automobile accident occurred. In addition we talk about what district we serve, what region is affected by a policy or event, the place a statistic represents or the place where it was gathered; where a cell phone call was made, where it was received or where the speakers are talking about; the room where a patient is in a hospital; or one of an innumerable other ways of relating phenomena to a location.

Geospatial services are computer software applications that process data and information to answer user requirements. These services process many of the 'where's' in the previous paragraph and provide great value in daily life. In their fullest sense, geospatial services are ubiquitous and cut across all lines of business in a multitude of applications. Systems that process geospatial information have tremendous potential to integrate information from

[**Geospatial**] **data**—data with implicit or explicit reference to a location relative to the Earth

**Source:** Adapted from ISO 19118:2005(E)

[**Geospatial**] **information**—information concerning phenomena implicitly or explicitly associated with a location relative to the Earth. Frequently used as a synonym to geospatial data, but technically, data are "dry" digitally represented facts or recorded observations which on their own have no meaning. They become information when interpreted and put in context by humans.

[**Geospatial**] **service**—service that transforms, manages, or presents [geospatial] information to users

[**Geospatial**] **information system**—information system dealing with information concerning phenomena associated with location relative to the Earth. – a collection of geospatial services.

**Source:** Adapted from ISO 19101:2002(E)

*Note that the bracketed term "geospatial" replaces the term "geographic" in the ISO definitions above. The term "geospatial" is not accepted in International circles, yet it is the favored term in the United States. Thus we use it interchangeably with the term "geographic" in this Geospatial Profile and adopt the above modified definitions.*

[8] The distinction between geospatial data and information is subjective and depends on the outlook of the observer and the context of the observation. Therefore the terms will be used interchangeably throughout this document.

seemingly disconnected activities and a variety of sources.

## 2.2 Overview of Geospatial Information and Services

This section provides a high-level overview of geospatial information and services as they relate to the mission requirements of governmental organizations.

Geospatial information is used in a variety of organizational settings. Examples of information include: building addresses; the location of transportation networks, utility networks, buildings and facilities, airspaces, and jurisdictional boundaries, and satellite and airborne imagery. The organizational settings include asset and personnel management, as well as management of environment, transportation, homeland security, defense and others. 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 (see Figure 2).

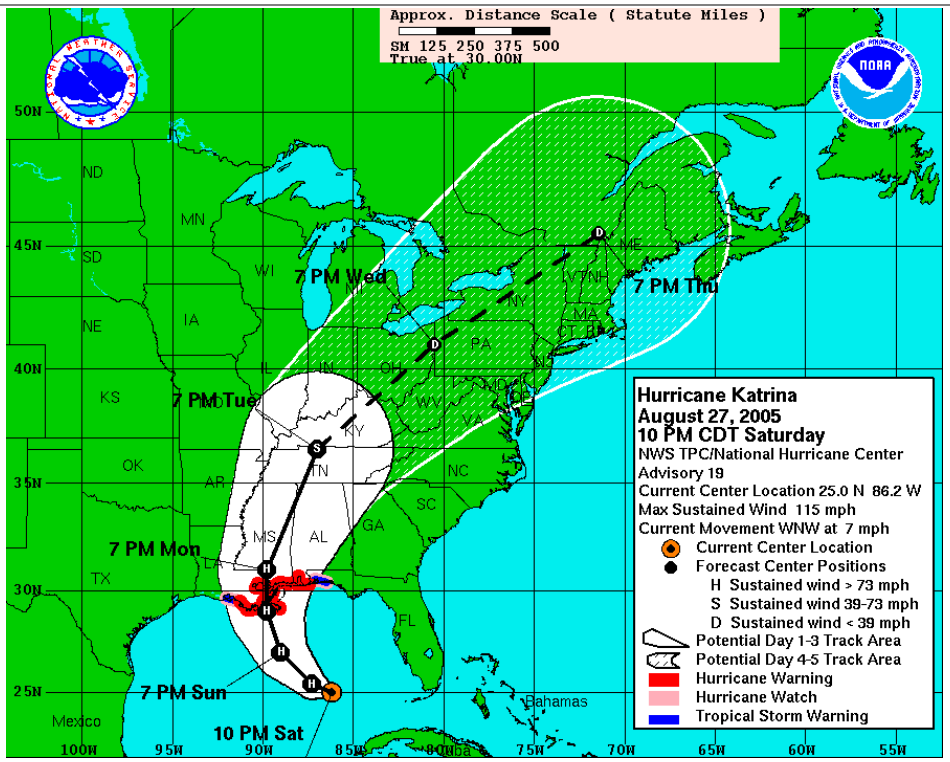


**Figure 2: Hurricane Katrina 5-day track warning and uncertainty cone.**

Geospatial information includes not only information that is obvious to most people as being geospatial in nature, such as elevations, satellite imagery, and location information acquired from a global positioning system (GPS), but also other types of information that many people may not think of as geospatial:

- Human resources systems capture the location of office buildings and rooms, and home addresses, for each employee
- Inventory and asset management systems generally identify the facility or room where a piece of equipment is stored or used

- Business performance reports often itemize results according to an organization's regions or jurisdictions

The geospatial aspects of these types of data can be used in many different ways to help improve the performance of a government or business organization. They also enable cross departmental use of data: The Departments of Housing and Urban Development and Housing and Human Services have thousands of mailing addresses that they use to manage assets – geospatial information that could be crucial in a Department of Homeland Security response to a national disaster.

In addition, in operational and support situations, a moving asset or phenomenon may be tracked according to its geographic location. Examples of a moving asset or reported or sensed entity or event include: aircraft, trucks, a vessel suspected of carrying contraband, and individuals on a watch list. Commercial companies such as FEDEX track every truck and package, but the Federal Emergency Management Agency (FEMA) cannot afford to do so because the cost is prohibitive without daily use of the system. An integrated solution with other agencies could afford the government the ability to build such a system and this profile is a tool to be used in that process from the signing of interdepartmental agreements to the design and implementation of the working system.

Any information that has an associated location can be used in geospatial queries, analysis, intelligence, and visualization. Combinations of data sources may be needed to provide an integrated view over time of events, tracked entities, and their locations. Such data combinations support decision-making during operational planning, preparedness, prevention, response, and remediation. Fire danger forecasting is just one example of the use of geospatial information along with geospatial queries, analysis, and visualization to support decision-making (see Figure 3).

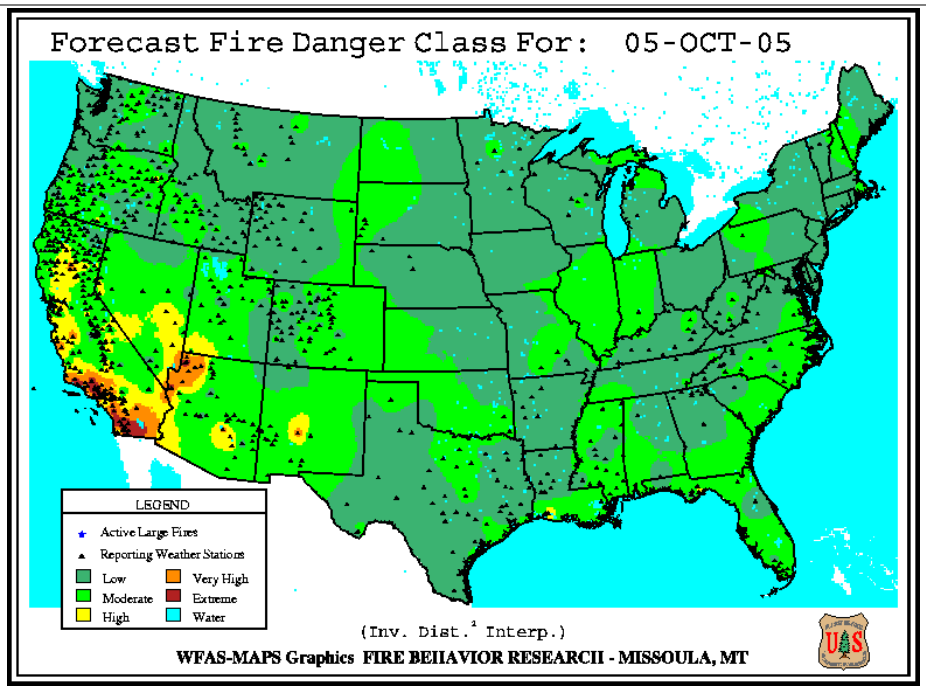


**Figure 3: Fire forecast created using geospatial information and analysis**

Geospatial services are well-defined processes that transform, manage, or present geospatial information to users. Examples of general-purpose geospatial services that may be used by many business applications include:

- Providing a display of agency information on a map background
- Determining the geographic coordinates corresponding to an address
- Identifying routes and creating directions for navigating from one location to another
- Analyzing the locational aspects of any problem or challenge.
- Creating online or paper maps (operational pictures) for visualizing a situation or event along with relevant geographic features and positions of entities of interest
- Performing a query to retrieve geospatial information based on geographic regions and/or political boundaries
- Converting geographic data from coordinate system to another

Geospatial services are often made accessible to users through a web browser, but may also be provided to users and other software applications through a variety of web-based applications and desktop client applications.

## 2.3 The National Spatial Data Infrastructure

This document is intended to provide federal agencies with the insights and information needed to take advantage of the Federal Enterprise Architecture as the government builds out its portion of the National Spatial Data Infrastructure (NSDI).. It provides a bridge between the data oriented NSDI that was started before the advent of Service Oriented Architectures and the new NSDI that will be oriented to the FEA and other Service Oriented Architectures.

OMB Circular A-16 provides guidance for federal agencies that produce, maintain or use geospatial data either directly or indirectly in the fulfillment of their mission. It describes the management and reporting requirements of federal agencies in the acquisition, maintenance, distribution, use, and preservation of geospatial data by the Federal Government. The Circular establishes a coordinated approach to electronically develop the NSDI and charges the Federal Geographic Data Committee (FGDC) to do so.

The NSDI is defined as the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve geospatial data.

The NSDI enables geospatial data from many sources (including federal, state, local, and tribal governments, academia, and the private sector) to be used together to enhance our understanding of our physical and cultural world. The NSDI honors several key public values:

- Privacy and security of citizens' personal data and accuracy of statistical information on people, both in raw form and in derived information products.
- Access for all citizens to spatial data, information, and interpretive products, in accordance with OMB Circular A-130[9].
- Protection of proprietary interests related to licensed information and data.

[9] Available as http://www.whitehouse.gov/omb/circulars/a130/a130trans4.pdf

- Interoperability of federal information systems to enable the drawing of resources from multiple federal agencies and their partners.

The NSDI supports and advances the building of a Global Spatial Data Infrastructure, consistent with national security, national defense, national intelligence, and international trade requirements. International compatibility is an important aspect of the NSDI. Federal agencies are to develop their geospatial data and technologies in compliance with international voluntary consensus standards, as defined by OMB Circular A-119[10].

OMB Circular A-16 addresses "data themes" that are defined as electronic records and coordinates for a topic or subject, such as elevation or vegetation. The Circular requires the development, maintenance, and dissemination of a standard core set of geospatial information for the nation that will serve as a foundation for users of geographic information[11]. This set of data consists of themes of national significance. Themes providing the core, most commonly used set of base data are known as "framework" data, specifically geodetic control[12], orthoimagery[13], elevation and bathymetry[14], transportation, hydrography[15], cadastral[16], and governmental units. Recently, the FGDC has published a series of data content standards that define the framework data themes. According to the International Organization for Standrds (ISO) definitions in the sidebar on this page, the content standards are "product specifications" for the framework "dataset series".

**Dataset**—identifiable collection of data.

**Dataset Series**—collection of datasets sharing the same product specification

**Product Specification**—description of the universe of discourse and a specification for mapping the universe of discourse to a dataset

**Source**: ISO 19113:2002(E)

*Note that the definition of "dataset series" is the closest definition to the concept of "theme" that can be found in the ISO/TC 211 terminology.*

OMB Circular A-16 mandates that "all geospatial data collected or derived directly or indirectly using federal funds will have FGDC metadata." "Metadata" are data about data (and/or geospatial services), such as content, source, vintage, spatial scale, accuracy, projection, responsible party, contact phone number, method of

[10] Available as http://www.whitehouse.gov/omb/circulars/a119/a119.html

[11] The themes (including an indication of which are "framework" themes) can be found in Appendix E of OMB Circular A-16

[12] Geodetic control surveys are usually performed to establish a basic control network (framework of known point locations) from which supplemental surveying and mapping work is performed. Geodetic network surveys are distinguished by use of redundant, interconnected, permanently monumented control points that comprise the framework for the National Spatial Reference System (NSRS) or are often incorporated into the NSRS.

[13] A digital orthoimage is a georeferenced image prepared from a perspective photograph or other remotely-sensed data in which displacement of objects due to sensor orientation and terrain relief have been removed. It has the geometric characteristics of a map and the image qualities of a photograph.

[14] Bathymetry is the measurement of the depth of bodies of water.

[15] Hydrography is the scientific description and analysis of the physical conditions, boundaries, flow, and related characteristics of the earth's surface waters. Hydrographic data typically refers to the boundaries of water bodies.

[16] A cadastre is a public record, survey, or map of the value, extent, and ownership of land as a basis of taxation. Cadastral data is the data representing the cadastre.

collection, and other descriptions. Metadata are critical to document, preserve and protect agencies' geospatial information assets. Reliable metadata, structured in a standardized manner, are essential to ensuring that geospatial information is used appropriately, and that any resulting analysis is credible. Metadata also can be used to facilitate the search and access of data sets or geospatial services within a clearinghouse or data library. Metadata is collected and supplied at the dataset level as the common practice within the geospatial community. It is the intention of OMB Circular A-16 that agencies supply metadata for each "dataset" created.

The NSDI includes the National Spatial Data Clearinghouse (Clearinghouse), an electronic service providing access to documented geospatial data and metadata from distributed data sources. In the terminology of ISO, the Clearinghouse is a register. In fact, the Clearinghouse has been implemented as a set of distributed registry nodes, each of which is a register for some number of datasets under the control of the Clearinghouse node owner. Agencies are required to use FGDC data content standards, the FGDC Content Standard for Digital Geospatial Metadata[17] (CSDGM), and other appropriate standards, documenting geospatial data with the relevant metadata, and making metadata available online through a registered NSDI-compatible Clearinghouse node.

**Catalog --** A collection of entries, each of which describes and points to a feature collection or a service. Often used as synonym for Register

**Metadata**—data about data.

**Source**: ISO 19115:2003(E)

**Register**—set of files containing identifiers assigned to items with descriptions of the associated items

**Registry**—information system on which a register is maintained

**Source**: ISO 19135:2005(E), adapted from ISO/IEC 11179

Geospatial information was also addressed in the E-Government Act of 2002. The purpose of Section 216[18] (Common Protocols for Geographic Information Systems) is to reduce redundant data collection and information; and promote collaboration and use of standards for government geographic information[19]. The NSDI is a key part of satisfying these Section 216 purposes.

Consistent with OMB Circular A-16, section 216 assigns responsibilities for the development of common protocols for the development, acquisition, maintenance, distribution, and application of geographic information. The FGDC has a central role in this work, in concert with private sector experts, state, local and tribal governments, commercial and international standards groups, and other interested parties.

Specifically, the E-Government Act states that:

> "the common protocols shall be designed to:

[17] Available at http://www.fgdc.gov/metadata/contstan.html

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

[19] 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.

(1) maximize the degree to which unclassified geographic information from various sources can be made electronically compatible and accessible; and

(2) promote the development of interoperable geographic information systems technologies that shall--

(a) allow widespread, low-cost use and sharing of geographic data by Federal agencies, state, local, and tribal governments, and the public; and

(b) enable the enhancement of services using geographic data."

Another component of the NSDI is Geospatial One-Stop (GOS), one of the initiatives under the President's E-Government Strategy[20]. GOS "provides federal and state agencies with single-point of access to map-related data enabling consolidation of redundant data." It has become the user interface to the Clearinghouse and is serving as the register of datasets as defined above. Furthermore, it registers planned dataset acquisitions via its "marketplace" functionality, enabling users to coordinate and, potentially, share acquisition costs. The GOS portal system has a registry (sometimes referred to as a catalog) that contains the metadata records for current datasets holding and planned dataset acquisitions. The portal also provides "geospatial services", such as access to web-based mapping and data access for the datasets that it registers, via "common geographic protocols" adopted by the FGDC.

*The National Map* is also a major federal part of NSDI. It contains much of the "framework" and other key content described in OMB Circular A-16. Specifically, it will contain the following:

- High-resolution digital orthorectified imagery from aerial photographs or satellite imagery that will provide some of the feature information now symbolized on topographic maps.
- High-resolution surface elevation data including bathymetry to derive contours for primary series topographic maps and to support Earth surface modeling and the production of accurate orthorectified imagery.
- Vector feature data for hydrography (rivers and water bodies), transportation (roads, railways, and waterways), structures, government unit boundaries, and publicly owned lands 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.
- Land cover data that classify the land surface into categories such as open water and high-density residential.

Figure 4 ties together all of the elements described in this section and depicts the key data and technology components of the NSDI. The diagram shows that the NSDI is a distributed network of data sources and services.

The "thin network" corresponds to the ability to discover, harvest, and publish metadata and can be thought of as the Clearinghouse network. Metadata describing the holdings at the data sources will have been either published to the Geospatial One-Stop registry or to a local registry node. Local registry nodes can be harvested to populate another registry, such as the Geospatial One-Stop

[20] The President's E-Government Strategy is available as http://www.whitehouse.gov/omb/egov/documents/e-gov_strategy.pdf

registry depicted in the figure. Local registry nodes or the Geospatial One-Stop registry can also be searched via distributed search protocols to perform discovery on behalf of an application. Metadata publishing can occur into any of the registry nodes that allow this capability and, in this way, participants in the NSDI do not necessary have to host a Clearinghouse node to participate as publishers of metadata.

The "thick network" correspond to the ability to access data and services made available via "common geographic protocols". Once an application (or the Geospatial One-Stop portal) knows that a dataset and/or that a service exists, then the application can access the service and use it for its intended purpose. Many services are possible and will be discussed later in this profile.

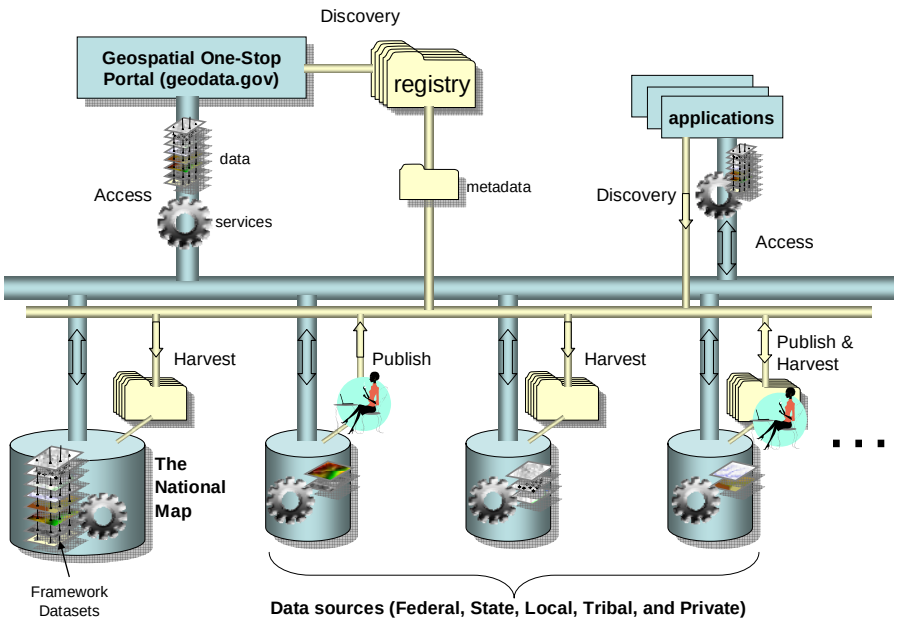


**Figure 4: Key technology components of the National Spatial Data Infrastructure (NSDI)**

In summary, the NSDI is intended to support the business of agencies and organizations in and out of the Federal Enterprise:

1) Providing access to geospatial data and services for all Federal lines of business and for state, local and tribal agencies, private businesses, students, teachers, researchers and ordinary individuals (via implementation of the Clearinghouse and Geospatial One-Stop in the NSDI)

2) Enabling the widest possible use of geospatial data and services ensuring that providers and users have knowledge of lineage and quality and means of ensuring appropriate security (via metadata publishing into the Clearinghouse and provisioning of data and services into the NSDI)

3) Facilitating the sharing of data and services through standards and specifications for interoperability (via the standards that FGDC creates or selects for use in the NSDI)

4) Providing a user-oriented delivery system which enables multiple means of delivery (via the implementation of the Clearinghouse and Geospatial One-Stop registries and the provisioning of data and services into the NSDI)

5) Ensuring that redundancy and waste are reduced to a minimum (via the sharing of data and services and the "marketplace" functionality of Geospatial One-Stop)

In conclusion, it is worth noting that a 1990 report by the Mapping Science Committee of the National Academy of Sciences concluded that

> "…because the demand for geographic data and base data consistency is so vast, the most important function of the USGS/NMD [National Mapping Division] in the future might be not to produce maps or even digital data, but to act as the interdepartmental administrator of the national geographic data infrastructure. (NRC, 1990)"

Fifteen years later, we see that this is indeed what is happening. It is also worth noting that most data cataloged in the Geospatial One-Stop Portal will not be Federal data. The most accurate and up-to-date data is data that is collected, maintained and used locally. As the new NSDI co-evolves with the information and communications infrastructure, Federal and non-Federal NSDI builders will find it easier and easier to comply with data, metadata and service interface standards, leading to realization of the NSDI goals. This profile will guide all of the government departments and agencies as they add their respective data and services to the NSDI.

# 3 Performance

The purpose of the FEA is to transform government such that it becomes "citizen-centered, results oriented, and market-based."

Four of the reference models that implement the FEA are purely descriptive—they provide taxonomies, respectively, for describing the functions (BRM), data (DRM), services (SRM), and technology (TRM) of government architectures. The fifth—the Performance Reference Model (PRM)—is normative. It sets targets for action and measures the degree of transformation achieved—improvements in the delivery of citizen services and in internal business processes.

Of all the FEA reference models, the PRM is of particular use to the development of fledgling geospatial programs across government because it provides this structure for analyzing means and ends. Unlike the other FEA- profiled functions (records management and security), which are derived demands of other activities, geospatial programs are mostly elective and opportunity-driven. The PRM provides a tool for focusing scarce geospatial resources most effectively, and for communicating to outsiders what benefits the geospatial program will provide, and how.

To date, use of the PRM has been mandatory only for Major investments under the Capital Planning and Investment Control (CPIC) program.21 The PRM is intended, however, to support performance evaluation of business programs, processes, and services as well as IT systems. Thus it is applicable to all activities of an agency's geospatial program—developing policies and standards, implementing geospatial services and geo-enabling functions within the organization, and providing geospatial data services outside the agency.

The Performance methodology of the Geospatial Profile begins with an overview of the FEA Performance Reference Model (PRM), describing its structure and discussing how it can be applied in principle to the activities, services, and investments of a geospatial program. It concludes with guidance of how to develop practical indicators in applied geospatial cases as part of the development of performance architecture.

## 3.1 Overview of the FEA Performance Reference Model

Adopting the philosophy of the value chain and program logic models of management theory, the PRM measures the performance of an activity, service, or investment by applying multiple measurement indicators in a logical sequence called a "line of sight."

There are four generic steps in a line-of-sight sequence: technology, people or fixed assets; process/activity; customer service; and mission and business results. Each step can have one or more "operationalized indicators" to measure (i.e., quantify) performance at that layer.

A performance line of sight is, in essence, a short narrative that explains the logic of how the activity, service, or investment is to be improved. Generically, improvement in technology supports improvement in process. This in turn improves customer service, which in the end improves a mission or business result.

[21] Clearly, it can and should also be applied to non-major investments as well.

Figure 5 illustrates the line-of-sight concept graphically. At the top of each step, the diagram provides the questions to be asked:

- What is the relevant technology involved (or fixed asset, or human resource)?
- What are the processes, activities, or services?
- Who are the customers?
- What is the ultimate purpose or mission?

The sequence can also be thought of as a progression of inputs, outputs, and outcomes, as indicated at the bottom of the figure.

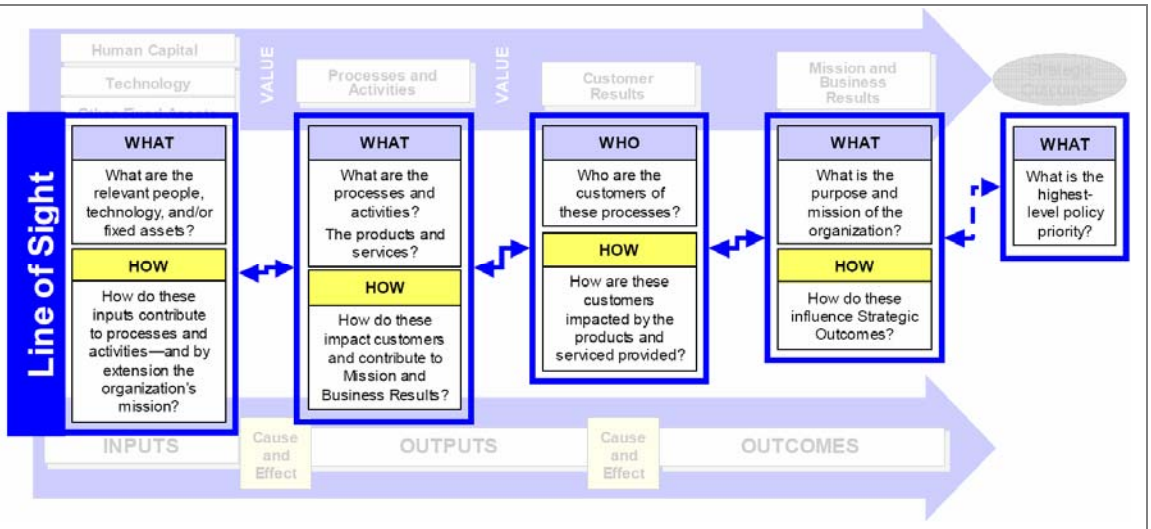


**Figure 5: The PRM Line of Sight**

For each step (called a measurement area) the PRM presents a taxonomy of types of indicators that make sense for that step. Each measurement area is broken down into categories and groupings. These act as prompts to the practitioner for inventing useful indicators. At the lowest level, the measurement grouping, it is up to the practitioner to define the right "operationalized indicators" to measure performance in the context of the line of sight narrative.

Interestingly, the PRM is the only FEA reference model that internalizes another reference model as one of its building blocks. The FEA Business Reference Model is the PRM's Mission and Business Results measurement area. The BRM's Lines of Business are the PRM's mission and business measurement categories, and BRM's Sub-functions are the PRM's mission and business measurement groupings. Agencies can elect to elaborate this measurement area to reflect their own decomposition of FEA BRM Sub-functions.

The other measurement areas are unique to the PRM—they do not refer to any other reference models. Figure 6 shows the full list of measurement categories. (Refer to the PRM for the list of measurement groupings within each of these measurement categories.)

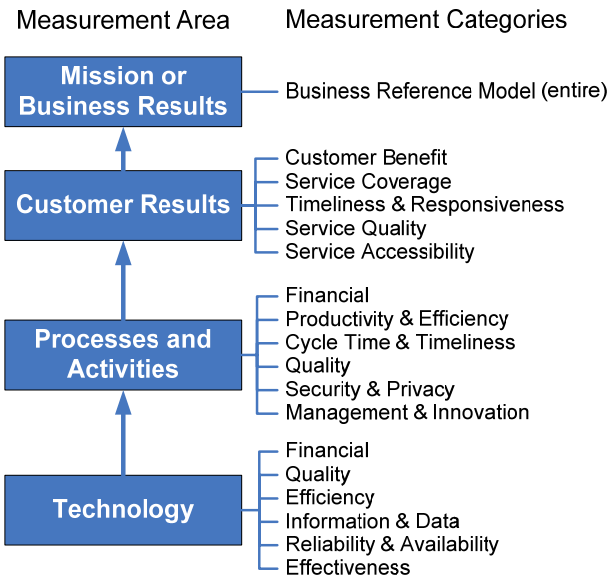


**Figure 6: PRM Measurement Categories and Measurement Areas**

It is an implicit requirement of the PRM that every operationalized indicator must have an identified and reliable data source. This is perhaps not adequately emphasized in other documentation, but must be kept in mind whenever the PRM is applied. In practice (i.e., in a review of Table 2 from selected Exhibit 300s), it is not uncommon to find indictors for which no obvious source of data is identified. Under Customer Results: Service Quality, for instance, an indictor might be to "increase customer satisfaction" with a particular data base. How is this to be measured? Through an annual customer satisfaction survey? What is the starting point? What is the objective? Every operationalized indicator must have a measurable baseline and objective, and should identify its source data.

Note that the bottom layer of the PRM, as published to date, is called "Technology." It does not yet include reference to human capital or non-IT fixed assets. This is because the mandatory application of the PRM so far covers only CPIC investments, which are almost always composed of IT systems. In the future, this layer will be elaborated in the next revision PRM to include more than technology (see discussion in Section 3.1.2 below).

Finally, note also that it is permissible to use multiple operationalized indicators at any step of a line of sight—i.e., to produce multiple lines of sight for a particular application. Avoid this! Virtually every initiative to which the PRM could apply might have its performance measured in multiple ways at every step, and the steps might change from year to year.[22] To minimize reporting and data development burdens, select only the indicators that are most telling for a particular circumstance.

### 3.1.1 Mission or Business Results

Mission results and business results should be distinguished from each other. The BRM provides a useful structure for doing this that directly relates to the development of geospatial programs.

[22] For instance, in the first year a technology improvement might be to add more bandwidth to a help desk network, the next year add more computers, the final year upgrade the software.

Mission results yield benefits to citizens. They are the outcomes of the functions and activities of the top layer of the BRM—Services to Citizens. Conveniently, every agency already has operationalized indicators that can apply to the Services to Citizens layer of the BRM—Government Performance and Results Act (GPRA) goals as defined in the agency's strategic plan. Since GPRA goals are quantified measures of agency performance and are officially adopted, they can and should be used whenever mission results (as opposed to business results) are the end point of a performance line of sight.

Business results are internal process results within an agency. They measure productivity or efficiency of functions that support the delivery of Services to Citizens. They therefore correlate to the Support Delivery of Services and Management of Government Resources layers of the BRM.[23] An agency's geospatial program is one such support function. Support functions may or may not have formal goals or objectives defined by their agencies. Where they do, these should be used as the relevant operationalized business results indictors in the PRM (see Section 3.2 below for more discussion).

### 3.1.2 Customer Results, Processes and Activities, and Technology

Unlike the mission and business results area, where operationalized indicators may already be available, the three other measurement areas of the PRM definitely require practitioners to develop their own context-specific indicators to measure performance in alignment with the various measurement groupings. These groupings are universally applicable—as far as they go, they are as valid for geospatial programs and investments as they are for any other cross-cutting support function. The question is whether the PRM may need to be expanded to more fully cover geospatial activities or services. Experience will tell, and future iterations of the PRM may include such expansions if the need becomes apparent.

In building a line of sight for an activity or service (as opposed to a technology investment) it is not always clear whether to include the first step of the PRM. The current version (August 2005) entitles this step "Technology," still omitting reference to human capital or non-IT fixed assets that can, in principle, be the focus of the first operationalized indicator of a line of sight. A geospatial program might, for instance, want to refer to the hiring of a qualified Geospatial Information Officer (GIO) as the step of a geospatial program performance line of sight.[24]

In this case one might align the hiring of the GIO under the "Reliability & Availability" measurement category, under the measurement grouping "Availability" (i.e., a qualified GIO will now be "available" to run the program). Obviously this is not exactly what is meant by technology availability as used in the PRM, but such an alignment might suffice.

Recommendation: either omit the Technology step of the line of site when measuring performance of an activity or service, or develop your own measurement category and grouping if you want to measure the performance of a human capital asset or non-IT fixed asset.

[23] Note that the PRM does *not* involve the Mode of Delivery layer of the BRM. Mode of Delivery is essentially an attribute of a service to citizens—it describes *how* that service is delivered, not *what* it is.

[24] "We will hire a qualified GIO by January, so that he or she can design a geospatial program tailored to our agency by June, so that we can provide geospatial services to our agency by December, so that our agency can improve its response to natural disasters in time for hurricane season the following summer."

## 3.2 Geospatial Performance Architecture Guidance

The Geospatial Profile recommends that agencies' geospatial programs organize themselves around three basic business functions (see Introduction and Chapter 4: Business):

**Develop Geospatial Policies, Standards, and Guidance.** This essentially involves localizing national and international geospatial standards for agency use, providing policies and procedures for implementing agency geospatial services, and developing guidance and training to improve an agency's geospatial awareness and abilities throughout the organization.

**Implement Geospatial Services.** This involves providing useful geospatial services—usually technology services—that are of most use for a particular agency, and "geo-enabling" existing applications and systems to take advantage of geospatial analysis.

**Disseminate Geospatial Data to External Users.** Not all agencies will be in the position of hosting geospatial data for external users, so this function and its related indicators may not always apply. When it does, this involves managing the geospatial data resource to make it responsive not only to internal users, but to all potential government and private sector users to whom it is made available outside the agency.

These functions imply a number of targets for developing geospatial performance indicators:

1. In relation to the geospatial program's own goals and objectives:

    a. Defining what policies, standards, and guidance a geospatial program needs to develop, when it must deliver them, and how it will ensure a high and consistent level of their use and maintenance throughout the agency. How will the agency measure the usefulness of the geospatial services and data provided?

    b. How the program will operate to discover and implement opportunities to geo-enable agency systems, or to provide new and useful geospatial services to one or more programs or bureaus within an agency.

    c. If applicable: how the program will operate and maintain data services for external users—how it will develop and maintain a community of users as advisors, what technological capabilities and levels of service it will need to develop, how frequently it should update or refresh its data, how it should archive data and document metadata, and so forth.

2. In relation to dedicated geospatial investments or services that generate their own CPIC documentation

3. In relation to geo-enabling other agency investments that are subject to CPIC requirements

In the first case, the starting point is to develop quantifiable goals and objectives that are appropriate to the geospatial program in its agency context. Because geospatial services are a support program, the program's goals and objectives will probably not align directly to the agency's GPRA goals, especially if the agency's business does not have a strong geographic component.

Geospatial programs may exist in multiple forms, and may in some cases be distributed throughout an agency without identifiable governance. In such cases it will be difficult to provide useful indicators of program performance in any measurement area, especially for customer results.

Also note that indicators of program performance will generally not include indicators for the Technology measurement area, though programs may wish to develop indicators for the performance of human capital or non-IT fixed assets.

The second case is the easiest context for performance measurement—it here that the PRM is already mandatory and in operation. In this case the investment, by definition, has a geospatial support function, so its measurement indicators can and must directly evaluate geospatial performance. An example might be the purchase of an enterprise license for GIS software, thereby making geospatial analysis available to every staff member of the agency.

The third case is similar to the second, but it is probably optional. A geospatial program might, for instance, consult with an agency's human resources operation to help them to geo-enable the agency's HR management system. In such a case, the outcome might be to use geospatial analysis to identify new facilities most conveniently located in relation to where employees happen to live, or analyze the need for tele-working programs if employees turn out to be widely distributed geographically. Neither of these capabilities would be the primary function of the HR management system, so a new line of sight would have to be added to existing performance measures for that system. This might unnecessarily add to the system's data development and reporting burden.

In summary, the ability to demonstrate value and improvement in business processes is crucial to the continued support and availability of resources. The geospatial PRM suggests areas of focus where indicators should be identified and measured that enable improved management of resources.

# 4 Business

The value of place or location-based analysis is often overlooked when modeling business processes, because enterprise architects and program managers typically think of geospatial data only in the context of a map or a remotely sensed image created with GIS applications. The coupling of *geospatial* data, services and technologies with conventional data, services and technologies can be one of the most significant enablers of improved decision making within business operations. It increases performance of key mission requirements across all levels of governments. This chapter is provided to help program managers and enterprise architects gain a better understanding of how they can incorporate geospatial data, services and technology into their business processes.

This chapter presents an overview of the FEA BRM and puts forth a geospatial view of the BRM, including a background and purpose of the FEA BRM and an explanation of the geospatial aspects of its elements and the relationship of the National Spatial Data Infrastructure (NSDI) to the BRM. The chapter also provides business architecture guidance in the form of a process that supports including geospatial components into the enterprise architecture of an organization. The chapter concludes with an example related to the Wildfire use case.

## 4.1 The FEA Business Reference Model

The Business Reference Model (BRM) of the Federal Enterprise Architecture is a function-driven framework for describing the business operations of the Federal Government. It describes the lines of business (LOB) independent of the agencies that perform them and categorizes them into four business areas. These are: Service for Citizens, Mode of Delivery, Support Delivery of Services, and Management of Government Resources (see Figure 7).

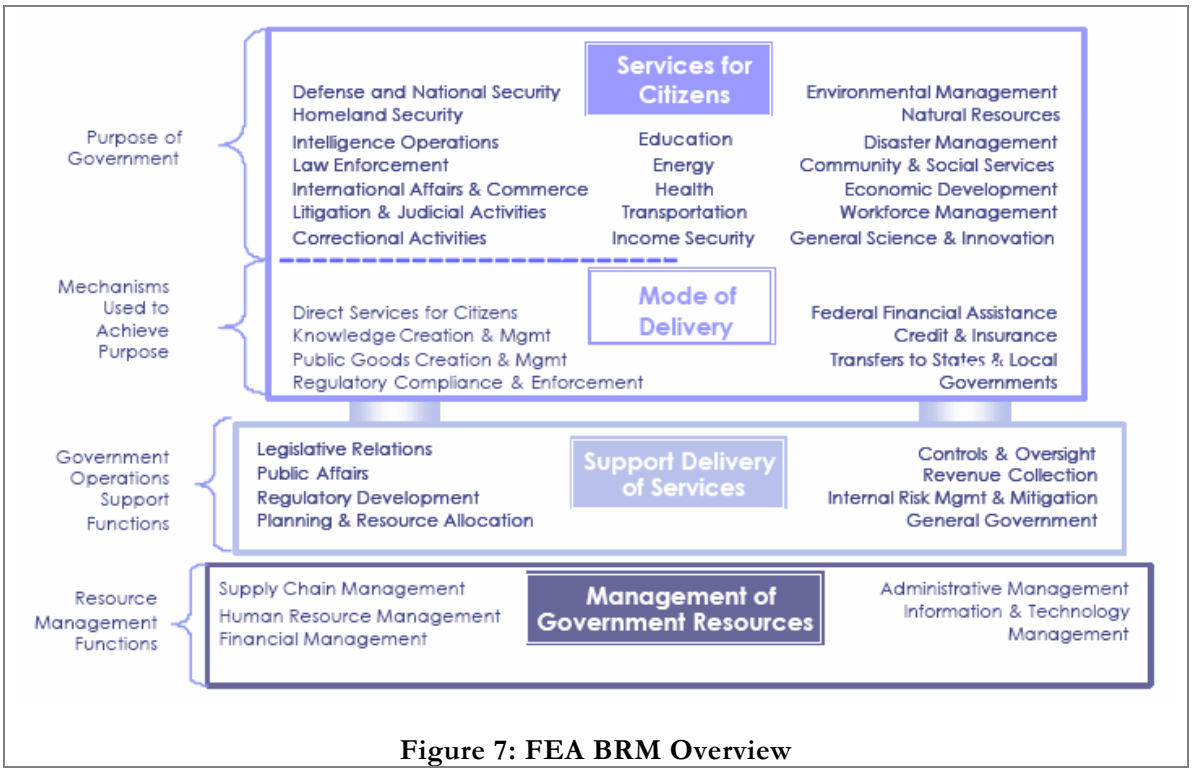


**Figure 7: FEA BRM Overview**

While a few of the LOBs and Sub-functions (sub-functions are not depicted in Figure 7) may be entirely implemented within a single agency, this is not the norm—particularly in the geospatial arena. Thus, agencies need to define the business activities that they perform and categorize them under the FEA BRM hierarchy. OMB can then appropriately manage these activities in a cross-agency environment, and agencies can discover and take advantage of services offered by other agencies that might benefit their business.

## 4.2 The Geospatial Aspects of the FEA Business Reference Model

While there is no independent geospatial line of business within the FEA BRM, geospatial information serves as a strong integrating force in many lines of business. Time and space, or when and where things happen (geospatial), are often common factors in business processes which are seemingly disconnected. They often help organizations and the public understand complex relationships that might be overlooked using other analytical methods. Use of geospatial information augments agency mission and business activities with the common view linked through location. Geospatial information, technologies, and services are still an underutilized resource for managing a multi-functional, distributed, and organizationally diverse enterprise such as the federal government. Our research indicated that all 32 LOBs delineated within the FEA can benefit from location based approaches to some extent.

Appendix E contains a table showing the business areas and lines of business within the FEA BRM. It then describes how geospatial data or services could play a primary or secondary role in the line of business and a description of the line of business. It also provides a set of example location based approaches that have been used within that line of business. For example, under the entry "Financial Management" line of business, the table indicates that location based approaches are not a primary component of this activity and thus it is rated a secondary user/creator. Under this LOB there is an example that geospatial approaches can be used to track grants and/or contract dollars by state or congressional district, then measure performance against goals. So it becomes clear that the

line of business does indeed have location content, and that that content could be utilized to analyze (and potentially improve) the geospatial distribution of grant/contract awards.

The information in Appendix E demonstrates the pervasiveness of location within the business activities of government. Twenty lines of business (63%) are identified as having primary geospatial elements. In the "Services for Citizens" lines of business 74% are identified as having geospatial as a primary element. The "Services for Citizens" lines of business represent the mission areas of government and are the critical areas where the improved use of geospatial information and technology can significantly increase the ability to meet the needs of the nation's population.

The ability to effectively identify the geospatial characteristics of an agency's business activities begins with a thorough analysis of the operational missions of the organization. The development of an accurate description of an organization's business activities (and value chains) and its business enterprise priorities will help managers and program officials determine geospatial activities within their business function. This topic will be covered in more detail in section 4.3.

## 4.3 Geospatial Business Architecture Guidance

For an organization to effectively use geospatial data and technologies, they must directly support the business of the agency. The BRM Enterprise Architecture of the organization provides a way to understand and document how geospatial supports the business. The primary goal of this section is to provide guidance on how to incorporate geospatial aspects into an organization's BRM such that those geospatial aspects are captured and brought to light to maximize the benefits of location based approaches to all parts of the enterprise.

The ability to develop this guidance assumes that some analysis of the enterprise business has already been done; that it has generated a series of business activities within the enterprise; and that these are documented so that further analysis can be conducted.

### 4.3.1 Process

The process described in this section is intended to help identify and define the geospatial aspects of any business activity. This process has three steps:

1. **Analyze business activity descriptions** to determine possible roles for location-based information in the execution of the business activity.

2. **Determine the function of geospatial** data, technology, and services in carrying out those activities.

3. If a locational aspect of the business activity exists, **develop or refine a business statement that describes the role of geospatial** data and technologies in support of the business activity. This statement will be called a Geospatial Business Statement in this process. Descriptions of the geospatial data, applications and services needed to support a business process may also be generated during this step to support the other perspectives of the enterprise architecture.

Further definition of these elements throughout the enterprise architecture process will result in improvements to the planning and implementation of the business processes supporting critical mission objectives as well as the services they deliver to citizens. If executed correctly, this process will ensure that organizations can show a direct connection between a business requirement and specific geospatial data, technology, and services.

The following list of questions is provided to help business managers, enterprise architects and program managers assess whether their operations could benefit from location based approaches, as well as to determine where and how to incorporate these approaches into the relevant business activity. Geospatial data, in the form of something as simple as an address, can also have useful value to other agencies and needs to be identified as geospatial so those agencies will recognize its potential for use.

For this process to be most effective, it is recommended that the business managers, architects, program managers and subject matter experts involved with the business activity jointly answer these questions for the business activities in which they are involved. If program managers and/or subject matters experts are not available or the time with them is extremely limited, it is recommended that the enterprise architect obtain key strategic and operational documents from the program managers and subject managers to fully understand the various components and their associated information flows. By using these documents to develop a concise understanding of the operation of a business activity, the enterprise architect can prepare a draft statement for review by program managers and subject matter experts for their approval. Regardless of the steps used, the following questions will be helpful in determining the role of location based approaches in that activity:

1. Is the activity associated with a place or a location?

2. Would the *addition* of a location component to the business activity enhance the business operation?

3. Does the activity description contain any of the following key words?

   address (physical), address (postal), area, bearing, bearings, city, community, compass, country, direction, distance, district, domicile, event, facility, geography, house, household, incident, latitude, locale, locality, locate, location, longitude, neighborhood, pinpoint, place, point, port, position, post, property, region, reservation, residence, river reach, route, scene, site, situation, space, spot, station, street, suburb, terrain, territory, topography, town, tract, venue, vicinity, village, watershed, where, whereabouts, ZIP code, zone

If yes, then further questions should be asked to determine the role of that keyword in the activity.

4. Does the place/position/location/address have or could it have an impact on the way that an activity is conducted? In other words, does the activity vary by place/position/location/address or do the characteristics of a place/position/location/address impact the activity?

If yes, then further questions should be asked to elicit more about how that activity varies spatially and what geospatial information and services may be relevant to the activity.

5. Does the activity require the use of or could it benefit from having a map/aerial photograph/satellite image?

   Would a map/aerial photograph/satellite image be helpful in the conduct of the activity or increase the effectiveness of individuals or groups conducting the activity?

6. Does the activity require the use of a Global Positioning System (GPS) or other location determination technology?

   Would the use of GPS or other location determination technology be helpful in the conduct of the activity or increase the effectiveness of individuals or groups conducting the activity?

7. Does the activity require knowing the location of any of the actors in the activity?

   Is the location of the actor(s) changing and is ongoing knowledge of the location(s) useful to the activity?

   Does an individual or group conducting the activity need to know their location?

   Does an individual or group managing the activity need to know the location of the individual or group conducting the activity?

8. Is it useful to know the address of the individuals or organizations being served by or affected by the activity?

This step of the process should result in written descriptions, using language familiar to the enterprise, that identify how the use of geospatial capabilities associated with a particular business activity adds value to the accomplishment of the mission.

Using these descriptions, the next step is to prepare the geospatial elements of business statements. Integrating the geospatial elements into the business statements will enable the architect to fully reflect the degree to which geospatial data, applications and services are or should be a part of a business activity. The following guidance is provided to help the enterprise architect prepare these Geospatial Business Statements.

The Geospatial Business Statements are written for each business activity for the purpose of specifying the geospatial components required to meet the business need. The Geospatial Business Statements are used to identify common data, application and services requirements and to target where the enterprise architecture can focus to provide the greatest possible business value to the organization or cross-government community. Geospatial Business Statements are written in sentence form and use the common definitions/descriptions contained in Appendix F. The Geospatial Business Language is provided to assist the geospatial community in adopting common terminology for geospatial terms. Taken in concert with the FEA Glossary and the Glossary included with this profile (Appendix B), the Geospatial Business Language will enable enterprise architects and business managers to have a directory of common descriptions which can be a growing community resource.

The Geospatial Business Language is comprised of five basic types of terms:

- **Application**—A computer program with a user interface or computer program component that employs geospatial data and technology; a geospatial business process, or sub-process that is implemented as a software program or program component.
- **Data**—A geospatial information class, type or property.

- **Function**—A geoprocessing capability; a geoprocessing user tool; a geospatial service component.
- **Process**—A general series of business activities that employs geospatial data and technology.
- **Technology**—An application of science that generates, displays, manages or otherwise processes geospatial data. (Excluding general-purpose Information Technology.)

Appendix F provides an initial list of Geospatial Business Language elements for use by enterprise architects. These elements are provided as a starting point to standardize the creation of uniform geospatial capability descriptions. It should be recognized that many more elements are possible. It is anticipated that additional elements can and will be added to this listing in the future. Agency architects should use the change management process being developed under the FEA governance process to make these changes.

Service Components (and in this case geospatial service components) are often identified over the course of analyzing business activities and they are recurring elements in the course of writing Geospatial Business Statements. When these common geospatial service components are identified, the enterprise architect can return to past Business Statements with geospatial elements and rewrite them based on the geospatial service component(s) that have been identified. This iterative process promotes the benefit of improved sharing in the course of continual architectural evaluation.

The section of this document describing the geospatial aspects of the Service Reference Model (see section 6.1) contains the background and reference to an initial list of Geospatial Service Components (Appendix G) for use by enterprise architects. However, it should be recognized that many more components are possible and that some care should be taken to generate or identify new Geospatial Service Components as this process is being used.

### 4.3.2 Geospatial BRM and the Wildfire Scenario

The Wildfire Use Case (Appendix D) involves a number of lines of business throughout the federal government. The most obvious are those relating to the **Disaster Management** line of business, which includes sub-functions such as *Disaster Preparedness and Planning, Emergency Response, and Disaster Repair and Restore*, but the effects of a fire do not end there. Residents are displaced, tourism may suffer, and public health and wildlife habitats are impacted. The lines of business that deal with these issues include **Community and Social Services**, which sub-functions such as *Homeownership Promotion and Community and Regional Development*; **Environmental Management's** *Environmental Remediation*; and **Health's** *Population Health Management and Consumer Safety, Health Care Administration and Health Care Research and Practitioner Education*.

The scenarios in **Use Case 1—Validate Fire Report and Plan Response** fall mainly under *Disaster Preparedness and Planning*. Many of the key factors in planning responses to disasters are geospatial in nature. For example, in Scenario 1.1 a wildfire, when reported, generates an EVENT record which includes various characteristics of the fire. The most basic of these are geospatial in nature, such as size and location. Scenario 1.2 determines the protection jurisdiction, which might compare the size and location of a wildfire (and probably its expected path) to the extents of federal, state, tribal and private lands. Other scenarios in this use case go on to develop the response plan, and rely on a number of geospatial data sets and models relating to weather forecasts, environmental conditions, and settlement density. Notice also that notification of other interested parties (such as nearby special interest groups) depends upon a detailed knowledge of their *proximity* to the event.

**Use Case 2—Implement and Execute Response Plan** is a highly complex event which can only be treated in a cursory manner here. However, even this most basic examination serves to highlight the pervasiveness of geospatial elements throughout the activity. *Emergency Response* is the main business sub-function in operation. In Scenario 2.1 there is a need to determine the current status and location of resources, which would be aided by geospatial query support by the *Logistics Management* sub-function of the **Supply Chain Management** line of business.

All of these scenarios involve the identification and cataloging of conditions and observations that occur in a particular time and place. Mapping this information, such as road closures, air space restrictions, species conditions, hazards, etc. and delivering maps throughout the planning, implementation and execution stages can improve the quality and timeliness of the response. For this reason all the lines of business mentioned should have geospatial visualization (mapping) capabilities.

After the wildfire has been dealt with, emergency response activities will end, but other government operations are just beginning. Disasters destroy homes, impact public health, and require mitigation of environmental impacts. Scenarios under **Use Cases 3 and 4** describe work that falls under very different lines of business, such as **Community and Social Services and Environmental Management and Health**. For example, fulfilling the *Homeownership Promotion* sub-function of Community and Social Services might involve providing special services for those citizens displaced by the wildfire. Having access to the fire's overall extent in relation to property locations would be an important part of the determination of eligibility for these services. A more sophisticated geospatial analysis might cross-reference journey-to-work data with the wildfire's impact to identify people at risk due to incident-related loss of employment.

### 4.3.3 How the NSDI relates to the Business Architecture

As stated in Chapter 0 of this profile, the NSDI includes the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data. From a business viewpoint, the use of common NSDI business practices enables the Federal community to use federal resources wisely and to build the NSDI across all levels of government. In developing their agency business architecture, federal agencies are encouraged to use the following NSDI-based business practices when conducting business process modeling and implementing the geospatial components of their enterprise architectures:

1) Prepare, maintain, publish, and implement a strategy for advancing geospatial information and related geospatial data activities appropriate to their mission lines of business.

2) Collect, maintain, disseminate, and preserve spatial information such that the resulting data, information, or products can be readily shared with other federal agencies and non-federal users, and promote data integration between all sources. This includes ensuring that data information products and other records created in spatial data activities are included on agency record management schedules.

3) Use data content, metadata, and other appropriate standards, document spatial data with the relevant metadata, and make metadata available online through the Geospatial One-Stop Portal network of registered NSDI-compatible Clearinghouse nodes.

4) Coordinate and work in partnership with federal, state, tribal and local government agencies, academia and the private sector to efficiently and cost-effectively collect, integrate, maintain, disseminate, and preserve spatial data. This includes using data

resources such as the National Map, Framework data resources and building upon local data wherever possible.

5) Use spatial information to enhance electronic government initiatives, to make federal spatial information and services more useful to citizens, to enhance operations, to support decision-making, and to enhance reporting to the public and to the Congress.

6) Protect personal privacy and maintain security of data and systems.

7) Search all sources, including the Geospatial One-Stop Portal and connected NSDI Clearinghouses, to determine if existing federal, state, local or private data meets agency needs before expending funds for data collection.

8) Allocate resources for effective collection, acquisition, maintenance, production, dissemination and stewardship of spatial data used for their lines of business.

To the extent possible program managers and architects should employ solutions for their business processes that utilize existing geospatial data and services, which may entail solutions hosted externally to their organizations, for example the use of Geospatial One-Stop. Following these NSDI business practices will enable all organizations to obtain the benefits summarized in Chapter 2.

# 5 Data

The Geospatial Data Reference Model addresses all the components, interfaces and processes for implementing and managing an integrated, cohesive geospatial data policy. These components include data documentation, development and adoption of data sharing standards and protocols, as well as the conceptual and logical design and modeling of the geospatial aspects of business data. Structuring and controlling the definition of this data will facilitate consistent use in and across the enterprise. Through the application of good geospatial data management practices, the quality of the data (and thus of the information which results from it) is improved. The mechanism for achieving this goal is outlined below across the three areas of data content, data sharing, and data description. Implementation of the ideas presented in these sections will reduce the difficulty of exchanging data and information (including data designs), reduce retraining requirements, and foster a common approach to addressing the geospatial component of your business data and its management. By promoting these concepts, the nation will benefit in the areas of sharing, accuracy, security and currency thus making the data more shareable than the historic model.

The purpose of this chapter is to provide guidance to enterprise architecture authors regarding how to describe geospatial data and metadata and guidance on alignment with the FEA DRM[25] while preserving the investments made by the geospatial community over many years. This chapter includes the geospatial view of the FEA DRM, including a background and purpose of the FEA DRM and an explanation of the geospatial aspects of its elements and the relationship of the National Spatial Data Infrastructure (NSDI) conventions to the DRM elements of data description, context, and sharing. The chapter concludes with an example related to the Wildfire use case.

## 5.1 Geospatial View of the Data Reference Model (Geospatial DRM)

### 5.1.1 Geospatial DRM Introduction and Overview

The FEA Data Reference Model (DRM) is intended to promote the common identification, use, and appropriate sharing of data/information across the federal government through its standardized characterization of data and information resources. The Geospatial DRM is intended to develop a standardized method to represent the locational aspect of that data. In keeping with the FEA DRM approach, the following three areas can be described as:

**Data Context**—A standard approach to representing taxonomies that an agency uses to categorize its data. The geospatial data context should reference existing locational and thematic taxonomies (e.g., FIPS codes, place names, mile markers) developed by the geospatial community, where possible.

**Data Sharing**—A standard approach to describing the characteristics and requirements of interagency data exchanges, including data sources. This defines a standard message structure known as an Information Exchange Package. Standard geospatial data exchange models include Framework Data (developed by FGDC and standardized through ANSI), the Open Geospatial Consortium (OGC) specifications, the National Information Exchange Model (NIEM) community-based model, and other standard encoding methods of locational information. As resources allow, these activities will be coordinated in the future to resolve issues and differences.

[25] As DRM 2.0 continues through its acceptance process, it is recognized that this chapter will potentially need to undergo significant revision.

**Data Description**—A standard approach to describing an agency's data resources. This is achieved through the application of the FGDC's geospatial metadata standard, the Content Standard for Digital Geospatial Metadata (CSDGM), to describe data sets and collections. The definition of standardized geospatial data elements and constructs is also required for interoperability.

### 5.1.2 Geospatial support for the DRM

The practices of the NSDI directly support the three standardization goals of the FEA DRM. Historically, the Federal geospatial community has designed its data management approach to share practices from the library and bibliographic community, with the intent of ensuring interoperability with that community.

#### *5.1.2.1 Data Context*

In the FEA DRM guidance, data context is supported through formalized categorization of data resources. In the geospatial realm, information resources can be classified using standardized conventions based on location and thematic content.

Data resources that have a geographic context, location, or coverage can be identified in one of two ways – by their approximate geographic extent or by an address in the context of a specific addressing system. The international standard for describing geographic information (metadata), known as ISO 19115[26], specifies an "Extent" to hold these geographic properties of an information resource. Extent allows one to describe a bounding area (polygon), a geographic bounding box (rectangle in latitude and longitude that encloses a resource of interest), a bounding volume (adding the third dimension of elevation or time, or a third and fourth dimension of elevation and time), or a geographic identifier such as a geographic name or place code for an information resource. Geographic identifiers can be used to categorize data spatially in the context of a published list of place name codes, and in some cases can even be used to navigate place name hierarchies. The location on and with respect to the Earth's surface in and of itself provides context, especially when associated with or related to a business terms such as "area of interest."

The second main style of geographic or locational identification is that of address. Although there may be many specialized uses for address (census, emergency response, routing, delivery, defining relative location or proximity) standardized constituent elements of a street address can support multiple use cases. ISO 19115, and its serialization in XML (ISO 19139), describe a contact address for geographic metadata that embodies these fundamental elements. The FGDC and its partner organization, the Urban and Regional Information Systems Association (URISA), are working to develop a multi-purpose address solution, the Address Content Standard, for use nationwide.

Geographic data are also categorized using a set of Topic Categories from ISO 19115 that help to organize the content of the information resource by thematic or application domain. The use of Topic Categories is compulsory in metadata records produced according to ISO 19115. These nineteen categories are expressed using a name and/or numeric code. Data may be classified in more than one category.

[26] In July 2003, ISO announced the approval and publication of ISO 19115, Geographic information - Metadata. The concrete XML encoding of 19115 (ISO 19139) should be progressed in November, 2005. Meanwhile, many organizations continue to use the Content Standard for Digital Geospatial Metadata (version 2.0), FGDC-STD-001-1998.

#### *5.1.2.2 Data Sharing*

How organizations structure their data holdings helps enable various data partners to share information based on place or location. Organizing data to be accessed by location enables data sets to be reused and geographically referenced. The effective benefits of sharing data in this manner include:

- Improving the ability to fuse disparate data types and providing a more comprehensive and holistic view of a particular problem set.
- Improving the ability to make connections and relationships based strictly on "where it is" and "what else is in the area."
- Enabling interoperability.
- Increasing communication and collaboration.
- Increasing productivity, saving time and money.
- Improving access to government information resources.

Geospatial information from different sources should be easy to integrate, combine, or use in spatial displays, even when sources contain dissimilar types of data (raster, vector, coverage, etc.) or data with disparate data element name schemas. For exactly this reason, the geospatial community has developed data sharing interface specifications that standardize on the data that is exchanged at the service itself, such as Web Map Service (WMS), Web Feature Service (WFS), and other Open Geospatial Consortium (OGC) specifications. By adhering to these guidelines, special displays and visualizations, for specific audiences and purposes, can be generated, even when many types of data and sources are required, all without the full extent of the data model being known. All of these service interfaces are compatible with standard methods for security, encryption and authentication of Internet resources.

It is important here to make the distinction between the need to access primarily geospatial data for display or visualization purposes, versus data that must be exchanged and fully integrated with other well-defined data structures, such as relational database systems. In this case, well defined schema representations are needed. The framework data standard establishes common requirements for data exchange for seven themes of geospatial data that are of critical importance to the National Spatial Data Infrastructure (NSDI), as they are fundamental to many different Geographic Information Systems (GIS) applications. The seven base geospatial data themes are: **geodetic control**, **elevation**, **orthoimagery**, **hydrography**, **transportation**, **cadastral**, and **governmental unit boundaries**. Framework data standards specify a minimal level of data content that data producers, consumers, and vendors are expected to use for the interchange of framework data, including through Web services. Basically, it is a lot simpler on all parties involved in data sharing to share with a common schema than with differing schemas.

Business data, often in a tabular form, may have a relatively small spatial component, but is equally important in the need to ensure its exchange is accomplished in a standardized manner. Whenever the Federal Government standardizes on a common reference to describe an address, location or geographic theme, business data components must be reconciled with geospatial practices and the standards referenced within this profile.

#### *5.1.2.3 Data Description*

The most important concept to keep in mind when discussing the definition and use of data element standards is predictability. Adhering to common geospatial data standards, agencies will be

able to: collect data once and use it often; warehouse geospatial data more effectively for various needs; and, better protect the privacy of individuals and digital rights of providers while improving access to non-restricted information.

The expected benefits of developing geospatial data element definitions include:

- Enabling effective sharing of information between collaborating partners - improving communication that, in turn, improves collections.
- Reducing the amount of manual intervention in information processing and integration, which increases productivity and can reduce costs.
- Providing a means for publishing the geospatial data element standards for the benefit of information exchange partners.
- Streamlining access to geospatial information to improve knowledge-worker workflow.
- Improving the quality, consistency, and interoperability of enterprise geospatial data assets and information.
- Supporting the ongoing adoption of the use of standard geospatial data elements in coordination with any kind of application or system modernization.
- Promoting the migration to a location-based services architecture, thus simplifying the process for improving and extending production systems.

This area includes two major parts. The first is a standard approach to describing and documenting an agency's geospatial data resources. The second is the actual definition of standardized geospatial data elements and constructs required for interoperability.

The documentation of an agency's geospatial data resources should be formulated through the application of a geospatial metadata standard, ISO 19115. This standard establishes a common framework for communicating information about geospatial data sets. The standard includes mandatory elements as well as recommended or optional elements. This information includes: identification of sources and stewards; details about the data's organization including number and type of features, spatial reference, and attributes including description of each attribute and definitions of acceptable ranges of values; descriptions of data quality; use constraints; as well as information needed to successfully access, transfer and process the data. Adopting a uniform standard for metadata allows all users of geospatial data to locate and evaluate that data with a predefined set of criteria. Creating and using geospatial metadata provides: information about an organization's data holdings to data catalogues and clearinghouses; information needed to process and interpret data; and the descriptive information to allow a business sponsor or an end user to choose the most applicable data set for their needs.

All federal government agencies are required, to the extent practical, to provide geospatial metadata that conform to this standard. Most state and many local governments have already adopted the FGDC metadata standard or a modified version of it. Utilizing this geospatial metadata standard allows developers to incorporate metadata components into their enterprise applications. This helps to facilitate the intergovernmental exchange of geospatial data and provides the information necessary to search for, assess, understand, and use geospatial data. Whether geospatial data are publicly available, For Official Use Only (FOUO), Sensitive But Unclassified (SBU), or classified, metadata can describe the data and be useful within the enterprise or between enterprises. It should be noted that even FOUO, SBU, or classified metadata is useful in the proper system contexts.

The second component, Data Element Definition, addresses the need for high-quality, consistent data in support of the business functions of government. The life cycle of data begins with data definition and entry, continues through transactional, operational and decision support, and ends with obsolescence and/or data archiving. Structuring and controlling the definition of geospatial data elements as well as the geospatial components of other data will ensure consistent use in and across government. The mechanism for achieving this goal is to use predefined, meaningful, geospatial data elements that are clearly understood by all information systems. This would include spatial elements such as address, location, projection, linear reference system, and geographic areas such as counties, block groups[27], and legislative areas.[28] This will reduce the difficulty of exchanging data and information including data designs, reduce re-training requirements, and foster a common approach to Data Management within government. By promoting the concept of federated data, government will benefit in the areas of reuse, accuracy, security and currency thus making the data more shareable than historically.

### 5.1.3 Geospatial BRM and the Wildfire Scenario

This section outlines the use of the guidance in this chapter in the context of the wildfire scenario in Appendix D. While not explicitly mentioned in the Basic Course of Events for the use case, a certain amount of base map information is required to support situational awareness and other operational planning, preparation, mitigation, response and recovery requirements. This base map information includes at least some of the following types of data:

- Orthorectified[29] aerial photography or satellite imagery (both historical and current)
- Transportation infrastructure (primarily road and rail networks, but also public transportation and inland waterway information)
- Utility networks—above-ground electric transmission lines, gas and water pipelines, storm and wastewater sewers
- Vegetation/Land Cover—vegetation type, structural type, sand/beach, etc.
- Demographics—population distribution (day and night-time distribution, if possible), socio-economic data (such as property values)
- Weather—wind speed and direction, cloud cover, and precipitation (both recent and current).
- Facilities of interest—Hospitals, fire stations, police stations, emergency operations facilities, sheltering locations (such as public buildings, schools, churches), and other critical infrastructure facilities (such as wastewater treatment, power generation/transmission facilities, hazardous material handling/usage)
- Response assets on the ground—emergency response personnel, emergency response apparatus (trucks, earth moving equipment, etc), command post locations, fire stations, police stations, emergency operations facilities, etc.

[27] Block group is the name for a subdivision of a census tract. A census tract is a small, relatively permanent statistical subdivision of a county or statistically equivalent entity, delineated for data presentation purposes by a local group of census data users or the geographic staff of a regional census center in accordance with U.S. Census Bureau guidelines. The block group is the lowest-level geographic entity for which the U.S. Census Bureau tabulates sample data from a decennial census.

[28] The FGDC organizes efforts to model some of the major thematic data elements as discussed in section 7.1.5.2 and on the Web at http://www.fgdc.gov/metadata/contstan.html.

[29] 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 can not be made.

- Alert or warning information—fire danger alerts and warnings, road condition alert (to include obstruction, damage, or destruction/failure information), etc.

In all of the above cases, both the data description and the data sharing mechanisms must be known. The schema of the data elements (the data element definition) and the possible valid values of the individual schema elements must be known in order to facilitate understanding and use. Where possible, the data should be made available via content standards, such as the Content Standard for Digital Orthoimagery (FGDC-STD-008-1999), Vegetation Classification Standard (FGDC-STD-005), Utilities Data Content Standard (FGDC-STD-010-2000), or the emerging FGDC Framework Data Content standards[30]. The alert and warning information should be made available using the Organization for the Advancement of Structured Information Standards' (OASIS) Common Alerting Protocol version 1.0. In some of the above cases, content standards do not exist or they may not adequately cover the geospatial aspects of the data (for example, in the case of the location of emergency apparatus and personnel). These should be considered gaps and they should be filled by efforts at the Federal, state, and local levels.

Further, it should be recognized that this information can come from many sources and that the data must be documented with appropriate metadata (as defined in the section on data description) using ISO 19115. Documentation of online mechanisms for data sharing should be included in the metadata (such as availability of the data as a map or feature data via common standard protocols such as WMS, WFS, or even FTP). The metadata should be published into the NSDI (as described in the preconditions for the use case in Appendix D). If the data is For Official Use Only or classified, it should be shared via an NSDI-compliant but secure information channel such as Homeland Security Information Network (HSIN) or Defense Information Systems Network (DISN).

## 5.2 Geospatial Data Architecture Guidance

Agencies should perform a business analysis that generates the geospatial data requirements including data model, geospatial and temporal coverage, accuracy, quality. The potential sources for that geospatial information, ranging from self-production, to usage of another agencies data product, to direct acquisition from commercial sources should be considered. This should yield a data architecture that defines information types and data requirements in terms of business needs. The architecture should also yield data sharing requirements (in the form of needs that must be filled by other agencies) and data sharing opportunities (in the form of data required by the agencies mission that have no other source outside of the agency and that could potentially be of use to other agencies). OMB Circular A-16 should be consulted and agency A-16 requirements should definitely be expressed within the data architecture. Appendix H contains a list of standards that might apply to agency data architecture (as a mapping from the data architecture to the agency TRM where these standards typically exist) and are provided as potential artifacts for inclusion therein.

[30] An overview of this work is found at http://www.fgdc.gov/standards/framework/index.html. The current status is available at http://www.fgdc.gov/standards/framework/status.html.

# 6 Services

The Federal Enterprise Architecture Program Management Office has developed a Service Component Reference Model as a baseline for categorizing and aligning federal business applications into common, reusable Service Components, which are categorized into appropriate service domains and service types. The FEA PMO has stated that "aligning the layers of the SRM to agency technology, business, and application architectures enables the categorization of an agency's IT investments, assets and infrastructure by the common definition and purpose of the Service Components in the SRM." Classifying Service Components according to the SRM framework can help reduce software maintenance and development costs through the systematic identification and elimination of redundant systems. Additionally, classifying systems furthers the development of a Component-Based Architecture, a key goal of e-government.

In line with the goals and objectives of FEA, and more specifically with the FEA SRM, this part of the FEA Geospatial Profile serves to:

- Build upon and extend the FEA SRM by defining, classifying, categorizing and recommending common, reusable geospatial "building blocks" – Geospatial Service Components – for sharing in government computing environments.
- Provide guidance to agencies concerning Geospatial SRM implementation and use, aligning with and leveraging existing federal guidance, FEA PMO and Federal CIO Council recommendations, and harmonizing with other significant Federal interoperability and resource sharing initiatives, such as the National Information Exchange Model (NIEM).

## 6.1 Geospatial View of the Service Component Reference Model (Geospatial SRM)

The successful adoption and use of the Geospatial SRM will depend on achieving consensus on a consistent, well-known and well-understood set of names and definitions for geospatial service components. This starts with terms defined by the FEA-PMO, Federal CIO Council and other Federal initiatives. It continues with efforts to unambiguously distinguish common Geospatial Service Components in terms of purpose and role (what business function(s) they perform), how they are described, and the nature of the associated interfaces and applicable standards (in the companion TRM). Consensus will not be easy unless this information is consistent, well-known and well-understood, i.e., the semantics regarding all aspects of the components are known and agreed upon. As with the other parts of the FEA, the language of the Geospatial SRM must be clearly stated and understood by all stakeholders.

### 6.1.1 FEA SRM

#### *6.1.1.1 Introduction and Overview*[31]

The FEA SRM is a business-driven, functional framework classifying Service Components with respect to how they support business and performance objectives. It serves to identify and classify Service Components that support federal agencies and their IT investments and assets. The model aids in recommending service capabilities to support the sharing of business components and services across the federal government.

[31] The information in this section is taken directly from the FEA Consolidated Reference Model.

The FEA SRM, constructed hierarchically, is structured across horizontal service areas that, independent of the business functions, can provide a leverage-able foundation for sharing of applications, application capabilities, components, and business services. The SRM is structured around Service Domains, Types, and components.

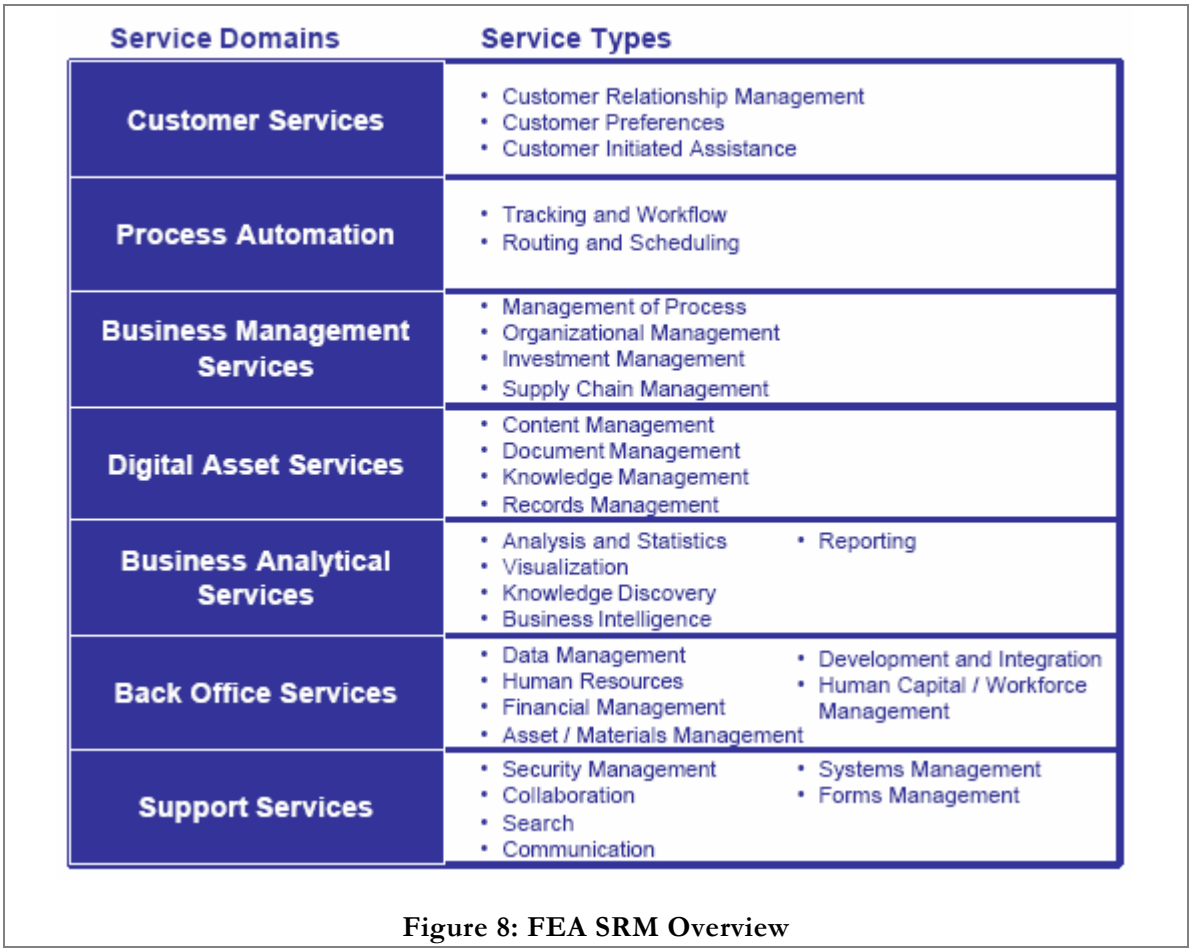


**Figure 8: FEA SRM Overview**

The FEA SRM Service Domains provide a high-level view of the services and capabilities that support enterprise and organizational processes and applications. They are differentiated by their business-oriented capability, and include:

- Customer Services
- Process Automation
- Business Management Services
- Digital Asset Services
- Business Analytical Services
- Back Office Services
- Support Services

Service Domains are comprised of Service Types that further categorize and define the capabilities of each Domain. As illustrated in the figure above, each Service Domain is classified into one or more Service Types that group similar capabilities in support of the domain. Service Types

provide an additional layer of categorization that defines the business context of a specific component within a given domain. Finally, each Service Type includes one or more Service components that provide the "building blocks" to deliver the component capability to the business. A component is defined as "a self contained business process or service with predetermined functionality that may be exposed through a business or technology interface."

### *6.1.1.2 Introduction to Components*[32]

The term "component" can represent many things to many people. It can describe a complete business line such as U.S. Treasury's PAY.GOV, a service supporting the validation of a Social Security Number, an application to support Content Management, or a capability that may be accessed through a technology or business interface. With multiple types of components available in industry and across governments, it became critical to the success of the SRM to define "component" and to clarify the level of granularity that will reside within the SRM.

**Component Granularity**

Table 1 illustrates the three levels of Service Component granularity that are viable for the SRM.

**Table 1: SRM Component Granularity Levels**

| Level | Definition |
|---|---|
| Business Component System | A set of cooperating business components assembled together to deliver a solution to a business problem. |
| Business Component | Represents the implementation of an autonomous business concept, business service, or business process. It consists of all the technology elements (i.e., software, hardware, data) necessary to express, implement, and deploy a given business concept as an autonomous, reusable element of a large information system. It is a unifying concept across the development lifecycle and the distribution tiers. Normally expressed as a sub-component of a larger business component system. |
| Distributed Component | The lowest level of SRM component granularity. It is a software element that can be called at run-time with a clear interface and a clear separation between interface and implementation. It is autonomously deployable. |
| Language Class (n/a) | A class in an object-oriented programming language to build distributed components. This is ***NOT*** considered an SRM component. |

[32] The information in this section is taken from the white paper entitled Service Component-Based Architectures, Version 2.0, June 2004, developed by the Federal CIO Council, Architecture and Infrastructure Committee, in collaboration with the FEA-PMO and the Industry Advisory Council. The purpose of this white paper is to inform agencies' thinking on development and use of enterprise architecture, in a manner consistent with Component sharing, and the objectives of the FEA. The document is available as http://colab.cim3.net/file/work/geocop/SCBA_2.0_FINAL.pdf.

#### *6.1.1.3 The Role of Geospatial in the FEA SRM*

Version 1.0 of the FEA SRM contains only one reference to geospatial. It aggregates all geospatial-related components under the *Business Analytical Services Domain, Visualization Service Type*, and a component identified as "*Mapping, geospatial (GIS), elevation, GPS"*. Clearly, not all geospatial-related capabilities can exist in a single functional business component and not all produce visualizations. As will be presented in the next section, the role of Geospatial Service Components is much broader than described in the current FEA SRM.

> *Note: The FEA SRM greatly oversimplifies the role of geospatial in the Federal enterprise. We may want to propose basic changes after we've had a chance to do a more thorough job fleshing out and vetting the FEA Geospatial Profile. For the time being, the approach is to perform a best-effort mapping to the existing SRM, effectively extending the SRM with a level of detail. In a few instances, changes to the FEA SRM are recommended. A goal of the Geospatial SRM is to much more clearly and accurately match the business and technology realities concerning the role of geospatial in a Federal, State, local and tribal enterprise.*

### 6.1.2 Geospatial Service Components

The Geospatial SRM identifies and defines a set of common Service Components that either geospatially extend those already identified in the FEA SRM or are entirely new entirely geospatially-oriented Service Components.

> *Note: The goal is to categorize the new and/or Extended Service Components into the framework of the FEA SRM (Figure 8). However, it is possible that new Service Domains and/or Service Types could be identified that would augment the FEA SRM. The primary initial sources for Service Components include the list that FGDC created for the GSA[33] and the DHS Geospatial Enterprise Architecture[34].*

The table in Appendix G contains Geospatial Service Components that are mapped to the FEA SRM. The first three columns represent the service domains, types, and components represented in the FEA SRM. The last three columns identify and describe the Geospatial Service Components. The description includes the level of service component granularity as defined in section 6.1.1.2, where BCS represents *Business Component System*, BC represents *Business Component* and DC represents *Distributed Component*. Again, this distinction is important because it emphasizes opportunities for integration, interoperability, and component sharing, which is important in OMB Exhibit 300 formulation and improved business effectiveness.

The distinction between component levels may be somewhat grey, at first, until the Geospatial SRM is applied and tested. For example, one agency's idea of an appropriate bundling of services as a Business Component, may not exactly mesh with another agency. For this reason, it is probably reasonable to expect initially that there will be greater consensus at the lower level (Distributed Components) rather than at the higher levels where business needs are more subtle and specialized.

[33] The work accomplished for GSA can be found at http://fgdc.gov/geoportal/

[34] This is available as http://colab.cim3.net/cgi-bin/wiki.pl?HomelandSecurityGeospatialEnterpriseArchitecture

The exception to this will be broadly appealing general-purpose systems, such as a robust Geographic Information System (GIS), as an Enterprise-wide Business Component System.

The asterisk (*) on a Geospatial Service Component is used to indicate that there is more than one entry for this component. This is done for cases in which the Geospatial Service Component does not fit neatly under the FEA SRM taxonomy of Service Components. There are also instances where new, recommended FEA Service Components have been created.

## 6.2 Geospatial Service Architecture Guidance

The Business chapter (see section 4.3) provides guidance for agency BRM development that will result in the identification of geospatially-enabled Service Components that may be general purpose, mission-specific, agency-specific, or business process-specific. The guidance in this section will match that guidance and will flesh it out further as required to support the development of effective, business-driven agency SRMs.

#### *6.2.1.1 Guidance Concerning Component Granularity*[35]

The effective identification, assembly, and usage of Service Components allows for aggregate business services to be shared across agencies and governments. These business services provide the functionality necessary to support business activities associated with BRM line of business sub-functions. Service Component aggregation will enable rapid building and implementation of components to support a given initiative or investment. The figure below illustrates the concept of aggregate services where multiple Service Components can support a business sub-function.

[35] Information adapted from Service Component-Based Architectures, Version 2.0, Federal CIO Council, Architecture and Infrastructure Committee, June, 2004.

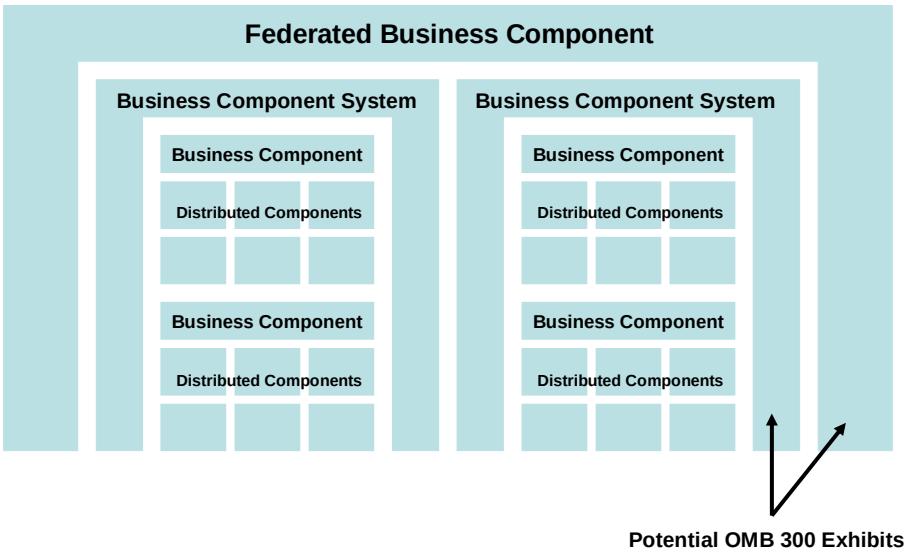


**Figure 9: Conceptual Hierarchy of Components**

The SRM is decomposed into lower levels of granularity beginning from the process and application levels to the software component and module levels. This level of decomposition provides various perspectives for stakeholders and solution architects to support the adoption of components and services within an IT initiative, asset, or investment.

### *6.2.1.2 Desired Features of a Service Component*[36]

An important consideration regarding the success of the FEA SRM is to have strong participation by the entire stakeholder community to ensure that the right Service Components are chosen and verified. The Federal CIO Council, in cooperation with the FEA-PMO, developed the following list of desired features to assist agencies in successfully defining Service Components; these definitions have been slightly altered for geospatial audiences.

> *Note: It is our view that this list of component features is solid and if strictly adhered to provides a sound set of guidelines for further developing the Geospatial SRM. Thus stated, component definition is not a science, and it will take several iterations and the efforts of many to produce wholesome content for favorable impacts to agency planning and review processes.*

A successful service component-based architecture requires the application of sound architecture principles to the definition and composition of components. The components in the architecture should exhibit the following basic features:

[36] Information adapted from Service Component-Based Architectures, Version 2.0, Federal CIO Council, Architecture and Infrastructure Committee, June, 2004.

*Encapsulation* - A component should clearly separate the definition of the services that it provides from its implementation of those services. This implies that the internals of a "well-behaved" service component are hidden behind a "contract" (agreed-upon application interface) between the component and the outside world. For example, a service component with a web mapping interface can be made available by a Business Component System (like a GIS) or as a stand-alone Distributed Component attached to another Business Component System (like a geospatially-enabled database management system).

*Consumability* - A component that is designated as the provider of certain services should be able to provide those services in a coherent and consistent manner to another software or business process. To the extent that is possible, components should provide services without restricting the operations of users. A component should not impose complex interdependencies on other external components (i.e., keep interfaces functionally simple). For example, a web mapping service component's output is a standard, common graphic format used by many existing applications (such as a web browser or any graphics processing application). Therefore a web map service can easily be integrated into any number of web or graphics workflows without building specialized software.

*Extensibility* - A well-behaved Service Component should be extensible in both the services it provides and the way those services are provided within the component itself. A well-behaved component should be extensible to adapt to changes in the business and data while at the same time preserving services provided to existing consumers.

*Standards-Based* - The value of a component increases in conjunction with the number of places the component is used. Standards, both technical and domain, affect this applicability in a number of ways. First, by basing the interface of a component on industry standard practices and technologies, the component is more likely to be shared. As an example, if a component is built using Cobol, sharing of that component in a .NET environment is relatively difficult and therefore is unlikely to occur. On the other hand, if a technology standard, such as Web Services Definition Language (WSDL), is used to create an interface for the Component, it can then be used from either Java or .NET with equal ease and will therefore see greater ROI. Further, if the interface is based on a domain industry standard such as GML or NIEM, even greater ROI is likely since a consortium of organizations have "pre-agreed" to adhere to the standard. The second reason standards help component sharing is that components need a compatible execution environment. This means that the implementation also benefits from being standards based. For example, if a component is written to Web Services Interface Standards, such as many OGC specifications, then it can be deployed in a fairly broad set of execution environments and therefore is more likely to be compatible.

*Industry Best Practices and Patterns* - A software component should embody industry "best practices" and patterns. Patterns are simply common solutions to recurring problems or issues faced in the software life cycle. Patterns typically reflect industry best practices—the convergence of approaches to solving problems. The use of (technology) patterns (and E-business Patterns) in components facilitates the understanding and consumption of the components.

*Well Documented* - A software component should be well documented to promote understanding of its capabilities and encourage its consumption. The documentation should permit architects, designers, and integrators to evaluate and consume the component. The documentation should include models (preferably in UML; for example, use cases, class diagrams, and sequence diagrams) depicting the process and data capabilities of the Component, user guides, functional over-views, and installation guides, as well as API documentation. A Test Harness should be delivered with the component to allow the consumer of the component to test each of the services or methods offered by it prior to consuming the component. If appropriate, the component should include the source code (for "white box" components) and a "management application" if the data managed by the component must be entered or updated independent of the consuming application. Finally, a component should be delivered with samples of consumption of the component to indicate how the component operates within an application environment.

*Cohesive Set of Services* - Components should be factored in such a way that they provide a cohesive set of services. Proper "packaging" of services makes the services easier to find and use. System developers and integrators are able to use just the right component for the need. Using components that offer too broad an array of services leads to bloated software and can result in bugs due to inadvertent use of features that are not appropriate. As an example, suppose an Image Processing Component included a complex array of image processing and data management functions for a certain type of imagery and its intended uses. While this might work well for an immediate community of specialized imagery analysts, further sharing would likely be limited. Creating appropriately factored service offerings will significantly increase the breadth of opportunities for component sharing.

*Well-Defined and Broadly Available Licensing or SLA* - A software component should be accompanied by a well-defined license or service-level agreement (SLA). The license or SLA defines the user's rights and responsibilities with respect to the component. In particular, the license or SLA should clearly articulate the intellectual property ownership for the Component, the scope of usage permitted, the extent of any rights granted to modify the component or produce derived works, and the extent of any rights granted to redistribute the component. For commercial-of-the-shelf (COTS) components, the copyright will usually reside with the original author of the Component, but the rights to use, modify, and redistribute can vary widely. To promote sharing of the Component, the license or SLA terms should be sufficiently broad as to allow the component to be shared in contexts other than its first intended usage without having to renegotiate licensing terms. So, for example, a site- or organization-wide license would be more appropriate than a single-processor license.

#### *6.2.1.3 Geospatial SRM and the Wildfire Scenario*

**Use Case 1—Validate Fire Report and Plan Response** describes two major activities, recording an INCIDENT REPORT and an EVENT, and planning the response to the EVENT.

The recording activities relate not only to the emergency at hand, but will also become an archival record of the scenario, used for evaluating the RESPONSE PLAN and developing guidance for future activities. As such, the recording of the INCIDENT REPORT and the EVENT fall under the **Back Office Service Domain's Data Management Service Type** (see Appendix G). The function of adding new data with a geospatial component is best described by the **Feature Update Service**

**Component**, which is a specialization of the **Extraction and Transformation Service Component**.

Planning the response to the EVENT requires a host of business analyses. These fall under the **Analysis and Statistics Service Type** of the **Business Analytical Services Domain**. Many geospatial items are defined under a new **Geographic Analysis Service Component** which are useful in this scenario. Weather Services will be used to access weather conditions and forecasts. **Model Services** may be used to predict the fire's path and spread. A **Geocoder Service** can LOCATE homes and critical facilities in the fire's path. And subsequently, **Route and Navigation Services** can help plan evacuations.

Under **Use Case 2—Implement and Execute Response Plan**, **Scenario 2.1** requires determining the LOCATION of resources, which identifies a need for geospatially enabled **Asset Management Systems**. As the resources are most efficiently GEOLOCATED by their enabling organizations, this is a back office function. **Facilities and Asset Management Components** are found under the **Back Office Service Domain's Assets – Materials Management Service Type**. Here geospatial versions of these more general FEA components have been specified.

While many of the assets and resources required will be identified in back office systems, the materials used to execute the Response Plan will include many geospatial **Visualization Service Types**, such as **Mapping, geospatial (GIS), elevation, GPS Service Components**. These will necessarily include **Situation Awareness, Mapping, Coverage, Feature, etc. Geospatial Service Components**.

**Use Case 3—Monitor Results of Response** and **Use Case 4—Redevelopment and Recovery** will use many of the same service components. It is important to note, however, that the activities under Use Case 4 will require a great reliance upon multiple agencies geospatially enabling their Back Office Service Components so that the Business Analysis functionality required has adequate data upon which to operate. The lack of geospatially enabled data warehouses has been a great impediment to the ability of agencies to develop highly effective, cross-agency analyses.

# 7 Technology

This chapter establishes the basic guidance necessary to help ensure that proposed IT solutions which have or desire a geospatial location component are in compliance with industry standards, and therefore are likely to integrate efficiently into a multi-agency information sharing and processing environment. Specifically, the chapter is intended to describe elements of proposed solutions using a standard vocabulary and categorization scheme that is an extension to the FEA TRM. This allows for comparison of those elements, facilitating the identification of overlaps and gaps, and opportunities for sharing technical solutions and standards. The chapter also provides example uses of the TRM with respect to the Wildfire scenario.

## 7.1 Geospatial View of the Technical Reference Model (Geospatial TRM)

Establishing and institutionalizing the Geospatial TRM will provide the guidance and direction the government needs to function as an integrated enterprise capable of accomplishing all of the missions for which it is, or will be, responsible. The goals of the Geospatial TRM are as follows:

- Improve interoperability[37] and information and service sharing across operational entities,
- Improve operational effectiveness and efficiency through the use of common concepts and tools,
- Improve security through the identification of common security services and standards, and
- Improve development and integration efficiency and responsiveness through the identification of a common infrastructure for applications.
- Promote vendor neutrality through the use of standards-based products and interchangeable services and components.

The Geospatial TRM is intended to support three principal uses in conjunction with standards profiles:

- Ensuring interoperability amongst internal and external systems and users,
- Guiding the design of system and technical architectures, and
- Providing the basis for assessing architectural compliance for technical solutions.

Interoperability is the primary goal. The Geospatial TRM uses the same structure as the Federal Enterprise Architecture (FEA) TRM to ensure interoperability with Service Components outside the geospatial domain.

The Geospatial TRM provides a technology-focused, vendor-independent view of the hardware and software services that will support the enterprise. It is intended to be used by systems architects, engineers, developers, vendors, service providers, and others involved in defining and creating new systems and modifying existing systems. This view identifies the technical services and capabilities

[37] The Geospatial Applications and Interoperability Working Group of the FGDC has created an excellent reference model called, *A Geospatial Interoperability Reference Model* (GIRM), that was used to ensure coverage of topics within this TRM. It is available as http://gai.fgdc.gov/girm/v1.1/

provided by a common IT infrastructure that system and application architects and engineers must consider when defining new systems or modifying existing systems.

### 7.1.1 Relationship to the Geospatial Service Component Reference Model (Geospatial SRM)

The Geospatial TRM must be viewed within the context of the Geospatial SRM. The functionally-oriented capabilities described in the Geospatial SRM in terms of "Service Components" are enabled by technical services described here. It is assumed that, as the Geospatial SRM matures, the Geospatial TRM will change in response.

### 7.1.2 Overview of the FEA TRM

The FEA TRM provides a view of technical services, protocols and interfaces (Figure 10) that are primarily concerned with supporting the implementation of Service Components, as defined in the FEA SRM. Geospatial technology is in many ways a special case of database technology, and therefore the architectural concerns of database technologies usually account for geospatial as well. For example, there is no need to account separately for geospatial in the high-level TRM category of **Service Access and Delivery**. However, geospatial technology transcends the database, and can also be considered visualization and analysis technology. For example, a web browser may need a geospatial plug-in to be able to display geospatial information, or it may just deliver images from a server through **Dynamic Server-Side Display** and **Content Rendering**.

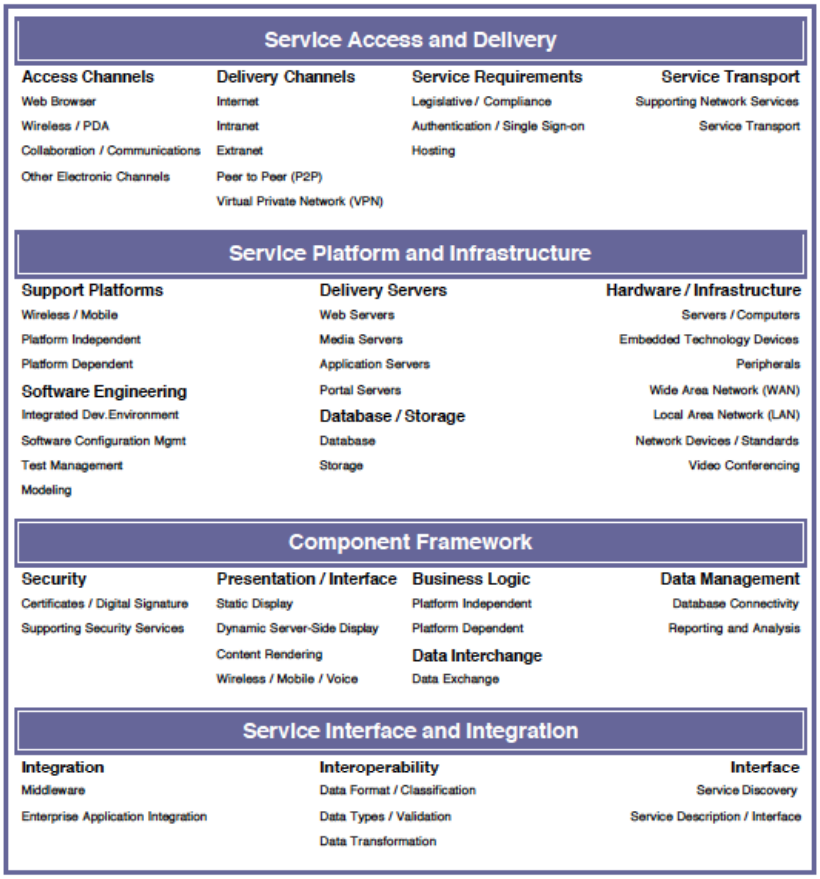


**Figure 10: FEA TRM Overview**

At the **Service Platform and Infrastructure**, **Component Framework** and **Service Interface and Integration** levels, however, the geospatial industry has defined a number of specialized systems and standards described in the following sections.

### 7.1.3 Service Platform and Infrastructure

#### *7.1.3.1 Database / Storage*

Database / Storage refers to a collection of programs that enables storage, modification, and extraction of information from a database, and various techniques and devices for storing large amounts of data.

**Database**

Refers to a collection of information organized in such a way that a computer program can quickly select desired pieces of data. A database management system (DBMS) is a software application providing management, administration, performance, and analysis tools for databases.

Geospatial database support at a minimum means that the database software has:

- a native geospatial data **format**
- geospatial **indexing**
- geospatial data access and processing **functions**

Less common is geospatial database support for advanced functions such as replication, long transactions, ACID[38] transactions, etc. This level of geospatial awareness, if present, is usually found only in products with native geospatial support described above.

### 7.1.4 Component Framework

The Component Framework consists of the design of application or system software that incorporates interfaces for interacting with other programs and for future flexibility and expandability. This includes, but is not limited to, modules that are designed to interoperate with each other at runtime. Components can be large or small, written by different programmers using different development environments and may be platform independent. Components can be executed on standalone machines, a LAN, Intranet or the Internet.

#### *7.1.4.1 Presentation / Interface*

This defines the connection between the user and the software, consisting of the presentation that is physically represented on the screen.

**Content Rendering**

This defines the software and protocols used for transforming data for presentation in a graphical user interface.

[38] "In databases, ACID stands for Atomicity, Consistency, Isolation, and Durability. They are considered to be the key transaction processing features/properties of a database management system, or DBMS. Without them, the integrity of the database cannot be guaranteed." –Wikipedia (http://en.wikipedia.org/wiki/ACID)

*Relevant standards:*

- OpenGIS® Styled Layer Descriptor Implementation Specification (SLD) version 1.0
  - https://portal.opengeospatial.org/files/?artifact_id=1188

    SLD is an XML encoding for how the Open GIS Web Mapping Service (WMS) specification can be extended to allow user-defined symbolization of feature data.

- OpenGIS Web Map Service Implementation Specification / ISO:19128 2005 (WMS) version 1.3
  - http://portal.opengeospatial.org/files/?artifact_id=5316

    Provides three operations (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple sources that are both remote and heterogeneous.

- ISO Geographic Information – Portrayal (ISO 19117:2005)

    This is an abstract document and is not intended for direct implementation. It gives general guidelines to the application developers about the mechanism that shall be used to portray the feature instances of a dataset. The portrayal mechanism described makes it possible to have general rules valid for the whole dataset, and at the same time rules valid for a specific value of a feature attribute only.

**Wireless / Mobile / Voice**

This consists of the software and protocols used for wireless and voice enabled presentation devices.

*Relevant standards:*

- OpenGIS Location Service OpenLS: Core Services Implementation Specification (OpenLS) version 1.0
  - http://portal.opengeospatial.org/files/?artifact_id=8836

    The primary objective of OpenLS is to define access to the Core Services and Abstract Data Types (ADT) that comprise the "GeoMobility" Server, an open location services platform. The GeoMobility Server provides content such as maps, routes, addresses, points of interest, traffic, etc. It can also access other local content databases via the Internet.

### *7.1.4.2 Data Interchange*

Define the methods in which data is transferred and represented in and between software applications.

**Data Exchange**

Data Exchange is concerned with the transmission of data over a communications network and the definition of data communicated from one application to another. Data Exchange provides the communications common denominator between disparate systems.

*Relevant standards:*

- OpenGIS Web Feature Service / ISO 19142 (WFS) version 1.1
  - https://portal.opengeospatial.org/files/?artifact_id=8339

    Allows a client to retrieve and update geospatial data encoded in OpenGIS Geography Markup Language (GML) from multiple Web Feature Services. The requirements for a Web Feature Service are:

    1. The interfaces must be defined in XML.

    2. GML must be used to express features within the interface.

    3. At a minimum a WFS must be able to present features using GML.

    4. The predicate or filter language will be defined in XML and be derived from Collection Query Language (CQL) as defined in the OpenGIS Catalogue Interface Implementation Specification.

    5. The data store used to store geographic features should be opaque to client applications and their only view of the data should be through the WFS interface. The use of a subset of XPath expressions for referencing properties.

- OpenGIS Web Coverage Service Implementation Specification (WCS) version 1.0
  - https://portal.opengeospatial.org/files/?artifact_id=3837

    Initially designed to extend the OpenGIS Web Mapping Service (WMS) interface to allow access to whole or portions of geospatial "coverages"—regularly varying *gridded* data sets such as aerial imagery. Over time WCS has diverged from WMS and beome more targeted towards the remote sensing community (note that WMS *may* also output geospatial coverages, but must always output standard web formats such as JPEG and PNG).

- OpenGIS Filter Encoding Implementation Specification / ISO 19143 (Filter) version 1.1
  - http://portal.opengeospatial.org/files/?artifact_id=8340

    This document defines an XML encoding for filter expressions based on the BNF definition of the OpenGIS Common Catalog Query Language as described in the OpenGIS Catalog Interface Implementation Specification, Version 1.0.

- OpenGIS Coordinate Transformation Service Implementation Specification (CT) version 1.0
  - http://portal.opengeospatial.org/files/?artifact_id=999

    To minimize errors associated with projecting a 3D surface (the earth) into a 2D plane, different earth *projections* are used by various state, local and federal agencies. This makes it crucial to have the ability to transform data from one projection to another as needed.

- Spatial Data Transfer Standard (SDTS): FGDC-STD-002

- http://mcmcweb.er.usgs.gov/sdts/

  The SDTS was designed by the USGS working with academic, industrial, and federal, state, and local government users of computer mapping and GIS[39] that saw a requirement for a robust way of transferring earth-referenced spatial data between dissimilar computer systems with the potential for no information loss. The SDTS is a standard for data transfer, as opposed to a standard for data processing. SDTS does not replace existing Geographic Information System (GIS) processing formats.

  NOTE: a modified version was adopted as ANSI INCITS 320:1998, which is undergoing periodic review through INCITS Technical Committee L1.

- SDTS Part 5: Raster Profile and Extensions: FGDC-STD-002.5
  - http://www.fgdc.gov/standards/status/sub4_1.html

    Contains specifications of a profile for use with geo-referenced two dimensional raster data, and excludes vector data and three dimensional and higher dimension raster data. It is intended to provide a common transfer format to be used for interchange of raster image and raster grid data among all members of the data producer and user community.

- SDTS Part 6: Point Profile: FGDC-STD-002.6
  - http://www.fgdc.gov/standards/status/sub2_3.html

    Contains specifications for a SDTS profile for use with geographic point data only, with the option to carry high precision coordinates (by increasing the number of decimal places or significant figures) such as those required for geodetic network control points can be attained.

- SDTS Part 7: Computer-Aided Design and Drafting (CADD) Profile: FGDC-STD-002.7-2000
  - http://www.fgdc.gov/standards/status/sub3_2.html

    Contains specifications for an SDTS profile for use with vector-based geographic data as represented in CADD software. The purpose of this profile is to facilitate the translation of this data between CADD packages without loss of data, and support the translation of this data between CADD and mainstream GIS packages. This profile supports two-dimensional vector data and three-dimensional vector data, where the third dimension is the "height" of the object. These data may or may not have topology.

### 7.1.5 Service Interface and Integration

#### *7.1.5.1 Integration*

Integration defines the software services enabling elements of distributed business applications to interoperate. These elements can share function, content, and communications across heterogeneous computing environments. In particular, service integration offers a set of architecture

[39] http://mcmcweb.er.usgs.gov/sdts/whatsdts.html

services such as platform and service location transparency, transaction management, basic messaging between two points, and guaranteed message delivery.

**Middleware**

Middleware increases the flexibility, interoperability, and portability of existing infrastructure by linking or "gluing" two otherwise separate applications.

*Relevant standards:*

- Information technology -- Database languages -- SQL multimedia and application packages -- Part 3: Spatial: ISO 13249-3:2003

  ISO/IEC 13249-3:2003: introduces the Spatial part of ISO/IEC 13249-3:2003 (all parts). It gives necessary references, defines notations and conventions, defines concepts, and defines spatial user-defined types and their associated routines regarding ISO/IEC 13249-3:2003.

  The spatial user-defined types adhere to the following: a spatial user-defined type is generic to spatial data handling. It addresses the need to store, manage and retrieve information based on aspects of spatial data such as geometry, location and topology; a spatial user-defined type does not redefine the database language SQL directly or in combination with another spatial data type.

- Simple Features for SQL version 1.1
  - http://portal.opengeospatial.org/files/?artifact_id=829

    The OpenGIS Simple Feature Specification application programming interfaces (APIs) provide for publishing, storage, access, and simple operations on Simple Features (point, line, polygon, multi-point, etc). This specification describes a SQL implementation of Simple Features.

- Simple Features for CORBA version 1.0
  - http://portal.opengeospatial.org/files/?artifact_id=834

    This specification describes a CORBA implementation of Simple Features.

- Simple Features for OLE/COM version 1.1
  - http://portal.opengeospatial.org/files/?artifact_id=830

    This specification describes an OLE/COM implementation of Simple Features.

### *7.1.5.2 Interoperability*

**Data Format / Classification**

Defines the structure of a file. There are hundreds of formats, and every application has many different variations (database, word processing, graphics, executable program, etc.). Each format defines its own layout of the data. The file format for text is the simplest.

*Relevant standards:*

- OpenGIS Geography Markup Language Encoding Specification (GML) version 3.1.1

- http://portal.opengeospatial.org/files/?artifact_id=4700

  The Geography Markup Language (GML) is an XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features.

- OpenGIS Web Map Context Implementation Specification (Context) version 1.1
  - https://portal.opengeospatial.org/files/?artifact_id=8618

    This document is a companion specification to the OpenGIS Web Map Service Interface Implementation Specification version 1.1.1, hereinafter "WMS 1.1.1." WMS 1.1.1 specifies how individual map servers describe and provide their map content. The present Context specification states how a specific grouping of one or more maps from one or more map servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. This description is known as a "Web Map Context Document," or simply a "Context." Presently, context documents are primarily designed for WMS bindings. However, extensibility is envisioned for binding to other services. A Context document includes information about the server(s) providing layer(s) in the overall map, the bounding box and map projection shared by all the maps, sufficient operational metadata for Client software to reproduce the map, and ancillary metadata used to annotate or describe the maps and their provenance for the benefit of human viewers. A Context document is structured using eXtensible Markup Language (XML). Annex A of this specification contains the XML Schema against which Context XML can be validated.

- ESRI Shapefile Technical Description 1998[40]
  - http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf

    A shapefile stores non-topological geometry and attribute information for the spatial features in a data set. The geometry for a feature is stored as a shape comprising a set of vector coordinates. This document provides all the technical information necessary for writing a computer program to create shapefiles without the use of ESRI® software for organizations that want to write their own data translators.

**Data Types / Validation**

Refers to standards used in identifying and affirming common structures and processing rules. This technique is referenced and abstracted from the content document or source data.

*Relevant standards:*

- Content Standard for Digital Geospatial Metadata (version 2.0): FGDC-STD-001-1998
  - http://www.fgdc.gov/metadata/contstan.html

    The objectives of the standard are to provide a common set of terminology and definitions for the documentation of digital geospatial data. The

[40] The shapefile is a very common format for geospatial information and the technical description is openly published on the Internet.

standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements. ISO harmonization efforts are underway.

- ISO Geographic Information – Metadata (ISO 19115:2003)

  This document defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data.

- ISO Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data (ISO 19115-2)

  ISO 19115-2 defines metadata elements to support imagery, and gridded data and will extend the UML model for metadata to include the following:

  • It will support the collection and processing of natural and synthetic imagery produced by remote sensing and other imaging processes.

  • It will support the collection and processing of geospatial metadata for imagery, gridded and coverage data.

  • It will define a data model for information describing geographic imagery and gridded data, establishing the names, definitions, and permissible values for new data elements including new classes relevant to imagery and gridded data.

- Content Standard for Digital Geospatial Metadata, Part 1: Biological Data Profile: FGDC-STD-001.1-1999
  - http://www.fgdc.gov/standards/status/sub5_2.html

    Provides a user-defined or theme-specific profile of the FGDC Content Standard for Digital Geospatial Metadata to increase its utility for documenting biological resources data and information. This standard supports increased access to and use of biological data among users on a national (and international) basis. This standard also serves as the metadata content standard for the National Biological Information Infrastructure (NBII). This standard can be used to specify metadata content for the full range of biological resources data and information. This includes biological data which are explicitly geospatial in nature, as well as data which are not explicitly geospatial (such as data resulting from laboratory-based research). This also includes "information" categories, such as research reports, field notes or specimen collections.

- Content Standard for Digital Geospatial Metadata: Extensions for Remote Sensing Metadata: FGDC-STD-012-2002
  - http://www.fgdc.gov/standards/status/csdgm_rs_ex.html

    These extensions define content standards for additional metadata, not defined in the Metadata Content Standard, that are needed to describe data

obtained from remote sensing. They include metadata describing the sensor, the platform, the method and process of deriving geospatial information from the raw telemetry, and the information needed to determine the geographical location of the remotely sensed data. In addition, metadata to support aggregation, both the components of an aggregate data set and the larger collection of which a data item may be a member, will be supported.

- Metadata Profile for Shoreline Data: FGDC-STD-001.2-2001
  - http://www.fgdc.gov/standards/status/sub5_6.html

    First in a series of standards that will define a Shoreline Data Content Standard. The metadata profile is to be used as an extension or profile to the existing Content Standards for Digital Geospatial Metadata (CSDGM). Because the CSDGM only allows for the documentation of generic geospatial data, the Bathymetric Subcommittee felt it was necessary to develop a metadata profile that addressed shoreline data and data that intersects with the shoreline. The objective of the metadata profile is to capture the critical processes and conditions that revolve around creating and collecting shoreline data. The metadata produced using this standard will be important for clearinghouse activities to locate potential data sets and to indicate the fitness for use and accuracy of a given data set. This Standard is intended to serve the community of users who are involved with geospatial data "activities" that intersect the U.S. Shoreline. The purpose is to clarify (standardize) some of the complexities of shoreline data by developing a metadata profile, bibliography and glossary, which will be an extension or profile of the FGDC CSDGM.

- Cadastral Data Content Standard: FGDC-STD-003
  - http://www.fgdc.gov/standards/status/sub3_5.html

    Support the automation and integration of publicly available land records information. It is intended to be useable by all levels of government and the private sector. The standard contains the standardization of entities and objects related to cadastral information including survey measurements, transactions related to interests in land, general property descriptions, and boundary and corner evidence data. Any or all of these applications are intended to be supported by the standard. The standard is not intended to reflect an implementation design.

- Classification of Wetlands and Deepwater Habitats of the United States: FGDC-STD-004
  - http://www.fgdc.gov/standards/status/sub3_4.html

    Provides a system that allows communication about wetlands and their features in a National context. Doing so enhances the ability of all agencies and individuals to interpolate and extrapolate wetland resource data, wetland loss and gain data, and restoration efforts in the same semantic and ecological context. The classification system was developed by wetland ecologists with the assistance of many private individuals and organizations and local, State, and Federal agencies.

- Vegetation Classification Standard: FGDC-STD-005
  - http://www.fgdc.gov/standards/status/sub2_1.html

    Supports the use of a consistent national vegetation classification system (NVCS) to produce uniform statistics in vegetation resources from vegetation cover data at the national level. It is important that, as agencies map or inventory vegetated Earth cover, they collect enough data accurately and precisely to translate it for national reporting, aggregation, and comparisons. Adoption of the Vegetation Classification and Information Standards in subsequent development and application of vegetation mapping schemes will facilitate the compilation of regional and national summaries. In turn, the consistent collection of such information will eventually support the detailed, quantitative, geo-referenced basis for vegetation cover modeling, mapping, and analysis at the field level.

- Soil Geographic Data Standard: FGDC-STD-006
  - http://www.fgdc.gov/standards/status/sub2_2.html

    This document proposes a set of data standards for the inventory, mapping, and reporting on the soil resources of the United States. It includes a description of the proposed data elements to be used when reporting and transferring data used to describe soil map units and their components. These map units are associated with soil maps developed by the National Cooperative Soil Survey.

- Content Standard for Digital Orthoimagery: FGDC-STD-008-1999
  - http://www.fgdc.gov/standards/status/sub3_6.html

    Defines the orthoimage theme of the digital geospatial data framework and envisioned by the FGDC . It is the intent of this standard to set a common baseline that will ensure the widest utility of digital orthoimagery for the user and producer communities through enhanced data sharing and the reduction of redundant data production.

- Content Standard for Remote Sensing Swath Data: FGDC-STD-009-1999
  - http://www.fgdc.gov/standards/status/sub4_4.html

    The standard defines the minimal content requirements for a remote sensing swath and the relationships among its individual components. It also discusses the treatment of optional supporting information within the swath model. In the classification system of the Federal Geographic Data Committee Standards Reference Model (FGDC 1997), this standard is a Data Content Standard. Data content standards provide semantic definitions of a set of objects and of the relationships among them. This standard defines a concept called a swath that provides a means for associating certain kinds of remote sensing data with their geolocation. To that end, it defines those items of information content that are necessary for the realization of the swath concept. As a content standard, the Content Standard for Remote Sensing Swath Data does not specify encoding. Encoding may be specified at some future time by a separate standard or standards.

- Utilities Data Content Standard: FGDC-STD-010-2000
  - http://www.fgdc.gov/standards/status/sub3_1.html

    This Utilities Standard supports large-scale, intra-city applications such as engineering and life cycle maintenance of utility systems. The components of each utility system described in this Utilities Standard are considered to represent features located outside the foundation of an enclosed structure. This Utilities Standard describes eleven feature classes: compressed air, electrical distribution, electrical monitoring/control, fuel distribution, heating/cooling systems, industrial waste, natural gas distribution, saltwater, storm drainage collection, wastewater collection, and water distribution. This standard does not contain all features necessary to describe or model communications, alarm systems, or long distance utilities networks that stretch between cities. As with the Spatial Data Transfer Standard (SDTS), this standard uses a logical data model.

**Data Transformation**

Data Transformation consists of the protocols and languages that change the presentation of data within a graphical user interface or application.

*Relevant standards:*

- OpenGIS Styled Layer Descriptor Implementation Specification (SLD) version 1.0
  - https://portal.opengeospatial.org/files/?artifact_id=1188

    SLD is an XML encoding for how the Open GIS Web Mapping Service (WMS) specification can be extended to allow user-defined symbolization of feature data.

- OpenGIS Web Map Service Implementation Specification / ISO:19128 2005 (WMS) version 1.3
  - http://portal.opengeospatial.org/files/?artifact_id=5316

    Provides three operations (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple sources that are both remote and heterogeneous.

### *7.1.5.3 Interface*

Interface defines the capabilities of communicating, transporting and exchanging information through a common dialog or method. Delivery Channels provide the information to reach the intended destination, whereas Interfaces allow the interaction to occur based on a predetermined framework.

**Service Discovery**

Defines the method in which applications, systems or web services are registered and discovered.

*Relevant standards:*

- OpenGIS Catalogue Service Implementation Specification (CAT) version 2.0
  - http://portal.opengeospatial.org/files/?artifact_id=5929&version=1

2051 Defines a common interface that enables diverse but conformant
2052 applications to perform discovery, browse and query operations against
2053 distributed and potentially heterogeneous catalog servers.

2054 **Service Description / Interface**
2055 Defines the method for publishing the way in which web services or applications can be used.

2056 OGC has done work in this area. Services may use WSDL as a way to describe endpoint
2057 bindings. More information is usually available by invoking a given service's *GetCapabilities* operation.
2058 This operation provides the calling application with more detailed, service domain-specific
2059 information. For example, in the case of the OGC Web Mapping Service, the *GetCapabilities*
2060 operation catalogs such features as available data layers and supported image formats.

2061 *Relevant standards:*
2062 - OpenGIS Reference Model (ORM) version 0.1.3
2063 - http://www.opengeospatial.org/specs/?page=orm
2064 The ORM describes a framework for the ongoing work of the Open
2065 Geospatial Consortium and its specifications and implementing
2066 interoperable solutions and applications for geospatial services, data, and
2067 applications.
2068 - OpenGIS Web Service Common Implementation Specification (OGC Common)
2069 version 1.0
2070 - https://portal.opengeospatial.org/files/?artifact_id=8798
2071 This document specifies many of the aspects that are, or should be,
2072 common to all or multiple OWS interface Implementation Specifications.
2073 Those specifications currently include the Web Map Service (WMS), Web
2074 Feature Service (WFS), and Web Coverage Service (WCS). These common
2075 aspects include: operation request and response contents; parameters
2076 included in operation requests and responses; and encoding of operation
2077 requests and responses.

2078 ### *7.1.5.4 Geospatial TRM and the Wildfire Scenario*

2079 This narrative describes how an agency would identify the technology standards needed to
2080 develop the service components mentioned in the SRM sidebar.

2081 In **Use Case 1—Validate Fire Report and Plan Response**, the need for geospatial data
2082 storage of the incident and related situational awareness information is identified. Collecting this data
2083 was classified into the **Back Office Service Domain's Data Management Service Type**. Two
2084 primary activities are required to develop this system: the definition of the geospatial data schema;
2085 and the ability to import, export and manipulate that data. These are **Data Classification** and **Data**
2086 **Exchange** Service Components. Note that the data classification does not require a unique
2087 geospatial service component as this is considered a general function. Geospatial data exchange,
2088 however, requires specialized technology to enable operations that identify, for example, the data
2089 elements within a certain distance of a location, or within a buffer zone of a road.

2090 Using this information it is easy to locate the **Data Exchange** *Service Standards* that are part of
2091 the **Data Interchange** *Service Category*, which in turn is part of the **Component Framework** *Service*
2092 *Area*. At this point the Data Exchange standards should all be evaluated for fitness for use. In this

case the most relevant standards are the **OpenGIS Web Feature Service/ISO 19142 (WFS)** for writing and reading geospatial vector data, and the **OpenGIS Filter Encoding Implementation Specification/ISO 19143 (**Filter**)**, for defining geospatially-enabled queries.

By implementing geospatial data access using these international standards, any other service component based on these standards immediately become potential clients of this information resource. With this systems integration stage completed, planning the response to the event can begin, which involves a great deal of visualization and analysis of disparate data sources. In the GeoSRM these activities fall under the **Analysis and Statistics** *Service Type* and the **Visualization** *Service Type* of the **Business Analytical Services Domain**. Many geospatial items are defined under a new **Geographic Analysis Service Component**. They are too numerous to treat in detail here, but the mappings are clear. For example, **Visualization** in the SRM maps well to the **Presentation/Interface** *Service Category* of the TRM. Here we find the **OpenGIS Web Map Service Implementation Specification/ISO:19128 (WMS)** and the **OpenGIS Styled Layer Descriptor Implementation Specification (SLD)** mapping and data portrayal standards to implement.

The SRM sidebar goes on to describe the other use cases, which for the most part use the same service components—mainly relating to data management and exchange, visualization and analysis. It becomes clear that a small number of geospatial standards can facilitate a great deal of information accessibility and exploitation. Much of the analytic work must still be performed in custom, unique software components and in the minds of domain experts, but the standards environment described here enables greater breadth and depth of information to be at hand.

## 7.2 Geospatial Technology Architecture Guidance

The implementation of the Geospatial TRM is accomplished through establishment and regular updates to geospatial entries in an overall Standards Profile. The initial Geospatial Standards Profile is in Appendix H and it contains a list of standards that might apply to agency technology architecture and are provided as potential artifacts for inclusion therein.

# 8 Organizational Maturity

Geospatial information, technologies and services can be important components of most governmental agency planning and business operations. As such they should be factored into the approaches outlined within each FEA reference model so they become integrated elements of the enterprise architectures being built using the Federal Reference Model guidelines.

At any given time, various organizations will be in different phases of integrating geospatial technologies, services, and data into their business and mainstream IT operations. The degree to which this incorporation has occurred can be measured through an integration maturity model. This section contains an initial draft of a proposed Geospatial Integration Maturity Model (GIMM) to measure the state of geospatial information and technology inclusion into an organization's enterprise architecture. The GIMM tool and its measures would be a good addition to PRM measures, PART, and the Enterprise Architecture Assessment Framework (EAAF) 2.0 (not yet publicly available) when designing performance architecture.

## 8.1 Geospatial Integration Maturity Model

The GIMM is intended to serve as a broad, outcomes-based assessment tool. The levels of maturity described are derived from activities and experiences encountered in both public and private sectors (federal, state, local, tribal, and private). The maturity measurements and tools from a variety of organizations have been merged into a single tool for assessing the degree to which geospatial policies, governance, data, technologies and services have been integrated into the enterprise architecture.

The GIMM serves several purposes. It enables organizations to measure their current level of geospatial integration, use a framework by which they can evolve to full integration, assess incremental progress toward full integration, and analyze how integration contributes to agency performance.

The maturity measurement categories outlined in the GIMM were derived from suggestions by a broad geospatial community. The community members have started documenting how to monitor benefits of an integrating geospatial data and information into mainstream business and IT operations. For example, many of the performance categories are related to categories contained in the National States Geographic Information Council's (NSGIC) Coordination Model[41]. It is envisioned that the performance categories and the specific metrics associated with each category, will continue to evolve as this model is prototyped, reviewed, refined, adopted and applied.

The maturity measurement categories included in the proposed GIMM are:

**Coordination**—The level of organized coordination, collaboration, and leadership for geospatial data, technologies, and efforts exist within an organization.

**Governance, Management, & Planning**—The degree to which plans and strategies for developing or leveraging the geospatial components of the business data exist within an organization.

41 The NSGIC State Model for Coordination of Geographic Information Technology (GIT) is a listing of critical factors for measuring performance objectives and the criteria needed for an effective statewide GIT coordination program. This document is available as http://www.nsgic.org/states/statemodel_git.pdf

**Policies & Compliance**—The existence of and use of compliance–based processes for assessing consistency of integration, adoption, and service implementation for geospatial technologies, data, and services.

**Enterprise Integration**—The degree to which the geospatial aspects of the business data collected by the organization are planned for, integrated, leveraged, and used to guide an organizations investments and future initiatives.

**Data Acquisition, Documentation, & Maintenance**—The stage at which the organization is for implementing geospatial data lifecycle processes such as development, documentation, and maintenance.

**Data Access & Distribution**—The degree to which an organization maintains and improves users ability to search for, discover, and access geospatial data.

**Standards & Best Practices**—The degree to which an organization adopts and complies with geospatial technology and process standards related to their business drivers.

**Training & Skills Development**—The level at which the organization as a whole is aware, understands, and communicates the potential utility and application of geospatial technologies to achieve the mandated activities.

OMB developed PART to assess and improve program performance so that the Federal government can achieve better results. This is done by identifying a program's strengths and weaknesses and informing managers on how to make the program more effective. The PART review process enables an assessment of factors that affect and reflect program performance including: program purpose and design; performance measurement, evaluations, strategic planning; program management; and program results. The PART guidance notes that performance measures should reflect a sense of prioritized achievement and should reflect both outcomes and outputs.

The draft, proposed GIMM follows the logic reflected in the OMB PART guidance. Within each maturity measurement category a range of possible geospatial indicators have been identified and arrayed into a maturity continuum expressed as levels 0 through 5. Level 0 is the lowest stage of maturity and Level 5 is highest level of maturity. This draft, proposed GIMM provides a consistent set of criteria as well as a framework by which project managers and key decision-makers can measure progress toward the goal of integrating geospatial data and technologies into the enterprise architecture.

Use of the GIMM enables an organization to document and baseline the current state of geospatial approaches, data, and technology integration within the enterprise. Conducting this baseline analysis establishes the reference point from which improvement targets can be set and progress measured. Once the relevant baselines are established, the next step is to use it to set performance targets for each GIMM maturity measurement category. Performance targets are quantifiable estimates or expected results during a given time period. It is against these targets that any performance improvement will be measured. Improvement strategies may span or affect any or all of the maturity measurement categories outlined in the draft proposed GIMM. The improvement targets set against each relevant indicator then serves as the measuring stick for progress within these maturity measurement categories. Once collected the performance information facilitated by the GIMM can be used make better decisions on how to integrate geospatial data and technology into the enterprise architecture, and as necessary, assess and re-assess the organization's path forward.

The categories and maturity levels in the GIMM model are as depicted in Table 2. A more careful examination of the levels described in the EAAF 2.0 and further work on consistency may result in adjustments to these levels and to the corresponding level descriptions within the GIMM elements.

**Table 2: GIMM Levels and Categories**

| Category | Level 0 No Program | Level 1 Informal Program | Level 2 Repeatable Program | Level 3 Well-defined Program | Level 4 Managed Program | Level 5 Continuously Improving Vital Program |
|---|---|---|---|---|---|---|
| **Geospatial Technology Baseline** | No geospatial technology baseline | Geospatial technology baseline documented | Geospatial technology baseline documented | Geospatial technology baseline documented | Geospatial technology baseline documented | Geospatial technology baseline documented |
| **Geospatial target architecture** | Geospatial target and Enterprise Architecture (EA) integration non-existent | Geospatial target and EA integration existent with informal adherence | Geospatial target and EA integration defined | Geospatial target and EA integration well-defined | Geospatial target and EA integration well-defined | Geospatial target and EA integration mature new effectiveness and efficiency targets based on business and technical goals |
| **Geospatial Standards** | No standards or standard operating procedures (SOPs) identified | Standards & SOPs identified compliance and tracking not consistent | Standards & SOPs tracked and verified along business lines | Standards & SOPs tracked and verified along business lines | Standards & SOPs tracked and verified along business lines | Standards & SOPs tracked and verified along business lines |
| **Process Reusability** | Geospatial processes are not repeatable and reusable | Geospatial processes are not repeatable and reusable | Geospatial processes are repeatable and reusable | Geospatial processes are repeatable and reusable | Geospatial processes are mature and shared to a great extent | Geospatial processes are mature and shared all across the agency |
| **Shared Templates and Components** | No templates or sharable components | No templates or sharable components | Developing templates and sharable components | Approved templates and sharable components | Approved templates and sharable components in use | Approved templates and sharable components in use across the agency |
| **Use of Metrics** | No metrics to track progress toward integration | No metrics to track progress toward integration | Developing metrics to track progress toward integration | Metrics used- are tracked and monitored in relationship to other general practices and business lines. | Metrics collected, analyzed-used to predict performance, better understand geospatial processes and capabilities in relation to lines of business and activities | Metrics inform ongoing improvements impact that changes have on geospatial processes and lines of business understood |

### 8.1.1 GIMM Category—Coordination

**Level 0**

- No geospatial coordination mechanisms
- Geospatial IT and activities pursued on a project-by-project basis.

**Level 1**

- Project-based coordination by independent groups with common geospatial IT and data needs

- Vested leader emerges for project duration; this leader is not consistent across projects within the organization.

**Level 2**

- Broad based coordination by organization with common geospatial IT and Data Needs
- Volunteer coordinator leads organization to goal
- No predictable pattern or frequency of coordination; dependent on availability of lead

**Level 3**

- Unofficial Single Department Coordination
- Key individuals act as coordinators with management approval
- Level of facilitation and coordination depend on tenure of key persons and organizational leadership

**Level 4**

- Official Coordination through a Geospatial Information Officer (GIO)
- Enterprise coordination to the extent granted by authorizing mandate

**Level 5**

- Official Coordination through a Geospatial Information Officer (GIO)
- System is in place to ensure that established coordination policies, guidelines and standards are followed, reviewed, and updated

### 8.1.2 GIMM Category—Governance, Management, & Planning

**Level 0**

- No Geospatial data , IT and services used to support/ leverage business processes or EA

**Level 1**

- Recognize location based approaches to support business and EA
- No enterprise approach to manage geospatial IT and activities

**Level 2**

- Vision exists for location based approaches to support business and effect process workflow efficiencies
- Relationship between location based approaches and lines of business, functions, processes identified
- Initial set of geospatial elements, tasks, database structure, and technologies to integrate location based approaches into business process workflows identified

**Level 3**

- Strategic plan /blueprint for integrating geospatial elements into the enterprise and EA
- Structured framework and timeline for developing the geospatial component of the business enterprise and EA established
- Geospatial governance roles and responsibilities outlined.
- Financial and staffing resource requirements outlined.

- Geospatial activities conducted according to Plan /Blueprint

**Level 4**

- Strategic plan /blueprint for integrating geospatial elements into the enterprise and EA
- Geospatial plans reviewed against business lines and programmatic mandates with changes incorporated to improve enterprise programs.
- Metrics in place to measure implementation progress against established geospatial goals, objectives, and task elements in plan
- Discussing geospatial metrics to help plan how geospatial components in the Enterprise Architecture should evolve

**Level 5**

- Strategic plan /blueprint for integrating geospatial elements into the enterprise and EA
- Geospatial action plans proactively developed and implemented to increase the effectiveness of the Enterprise Architecture based on captured Metrics and to allow identification of opportunities across business lines
- Inter-organizational coordination and collaboration at multiple levels of government is important; goal is to enhancing the NSDI and geospatial components of the FEA.

### 8.1.3 GIMM Category—Policies & Compliance

**Level 0**

- No geospatial compliance process exists
- OMB Circular A-16 mandate ignored

**Level 1**

- Compliance is informal and unstructured
- Recognize need to comply with geospatial standards outlined in OMB Circular A-16
- Compliance measurement difficult due to inconsistent processes and procedures and/or implementation.

**Level 2**

- Compliance remains informal and unstructured
- Structuring a compliance process to meet enterprise geospatial and OMB Circular A-16 standards

**Level 3**

- Formal geospatial compliance process is part of the geospatial data lifecycle
- Waiver request and business justification required for variance from enterprise geospatial standards
- Compliance process used as filter during development and review of application or data development proposals

**Level 4**

- Formal geospatial compliance process is part of the geospatial data lifecycle
- Compliance with geospatial standards common practice throughout organization.

- Compliance metrics developed or described.

**Level 5**

- Formal geospatial compliance process is part of the geospatial data lifecycle
- Compliance with geospatial standards common practice throughout organization.
- Compliance metrics drive continuous process improvements
- Geospatial compliance process is continually reviewed and updated as deficiencies or enhancements to the process are identified.
- Organization works with multiple levels of government to improve compliance process

### 8.1.4 GIMM Category—Enterprise Integration

**Level 0**

- No program for geospatial integration into the enterprise architecture
- Single geospatial issue solved by multiple groups multiple times

**Level 1**

- Geography/location recognized as a central organizing principle within/across lines of business
- Geospatial activities are project specific resulting in redundant acquisitions, development, and training
- Critical model elements identified

**Level 2**

- Recognize and document the need to integrate geospatial components into the lines of business and services of the EA
- No Plan for integration process
- Touch-points between geospatial components (technologies, standards, processes, services, analyses, etc.) and lines of business and outcomes mapped

**Level 3**

- Initiated integration of geospatial components into the lines of business and services of the EA
- Geospatial aspects of the EA program are integrated with strategic planning and budget review and approval.
- Touch-points between geospatial components of business lines and processes well defined - enable higher levels of information integration, analysis, and presentation.

**Level 4**

- EA guides geospatial development and acquisition.
- Metrics used to measure resource and time savings by leveraging geospatial technologies within their data models, applications, and data base systems.
- Costs and benefits integrating geospatial components into the IT environment and across agency boundaries considered in identifying projects
- Geospatial technologies enhance decision-making, stream-line business processes, and add significant analytical capabilities to the enterprise IT environment

- Geospatial integration procedures reviewed and updated to address new problems or functionality.

**Level 5**

- EA fully encompasses geospatial functionality and drives continual evolution of geospatial initiatives throughout the enterprise
- Lines of business drive geospatial technology deployed and geospatial technology influences how and what can be delivered along business lines
- Metrics used to proactively identify improvements to the geospatial integration processes.
- Partnerships with multiple levels of government to share ideas for improved geospatial integration, including the areas of procurement, project management practices, application development, and system administration.

### 8.1.5 GIMM Category—Data Acquisition, Documentation, & Maintenance

**Level 0**

- No Geospatial information development and maintenance processes
- Geospatial data not documented

**Level 1**

- No enterprise standards for documenting Geospatial processes and data elements across lines of business or their geospatial technologies
- Geospatial data development, documentation and maintenance processes ad hoc, informal, and often not consistent across departments

**Level 2**

- Enterprise data acquisition and development standards are in place and utilized
- Basic FGDC compliant geospatial metadata is collected and documented
- Processes are planned and tracked for quality assurance and quality control reporting.
- Use enterprise maintenance methods for capturing and providing back-up of time-critical geospatial information elements are in initial stages.

**Level 3**

- Enterprise data acquisition and development standards are in place and utilized
- FGDC compliant geospatial metadata templates used to capture information consistently
- Enterprise Geospatial data lifecycle processes defined and documented including stewardship roles and responsibilities, archival rules and retention etc.
- Standardized enterprise acquisition and development processes used as foundation for interoperability with other organizations

**Level 4**

- Enterprise data acquisition and development standards are in place and utilized
- FGDC compliant geospatial metadata templates used to capture information consistently

- Enterprise Geospatial data lifecycle processes defined and documented including stewardship roles and responsibilities, archival rules and retention etc.
- Routinely use metrics to measure effectiveness of geospatial data development and maintenance processes against business objectives
- Routinely use corrective action plans when deficiencies in geospatial metadata templates and/or procedures identified or as geospatial technologies evolve or sunset
- Standardized enterprise acquisition and development processes used as foundation for interoperability with other organizations.
- Regular Intra-governmental meetings held to review status and goals of data development activities in relation to the NSDI Framework

**Level 5**

- Enterprise data acquisition and development standards are in place and utilized
- FGDC compliant geospatial metadata templates used to capture information consistently
- Enterprise–wide use of prescribed geospatial lifecycle processes routine
- Inefficiencies in data development or acquisition processes identified routinely by metrics versus by oversight authorities
- Standardized enterprise acquisition and development processes used as foundation for interoperability with other organizations.
- Organization shares ideas for improvement to geospatial processes and templates with multiple levels of government
- Regular Intra-governmental meetings held to review status and goals of data development activities in relation to the NSDI Framework.

### 8.1.6 GIMM Category—Data Access & Distribution

**Level 0**

- Enterprise unaware of geospatial data and information available or the benefit of knowing

**Level 1**

- Minimal documentation exists about geospatial data assets or possible distribution methods and improvements
- Identified need to create greater awareness about geospatial assets

**Level 2**

- Geospatial data assets documented and distribution activities emerging/developing
- Need for geospatial data discoverability and access communicated to management.

**Level 3**

- Geospatial data holdings well defined and communicated.
- Inter-departmental access and distribution activities exist

- Interagency data sharing and distribution agreements formulated

**Level 4**

- Geospatial data holdings digitally available and searchable through an FGDC metadata clearinghouse node
- Sharing and distribution agreements for geospatial data in place
- Use metrics to measure extent and effectiveness of data discoverability, access, and distribution activities
- Inter-governmental access and distribution activities developed

**Level 5**

- Geospatial data holdings digitally available, searchable, and downloadable through an FGDC data clearinghouse node
- Extensive sharing and distribution agreements in place to improve the communication and exchange of geospatial data.
- Use metrics proactively to identify opportunities for improved data services.
- Inter-governmental access, distribution, and update activities are deployed.
- Partnerships with multiple levels of government to share ideas for improvements to the national geospatial clearinghouse.

### 8.1.7 GIMM Category—Standards & Best Practices

**Level 0**

- No documentation of business drivers for use of geospatial approaches, data, and technology
- Geospatial technology standards and best practices not known across the enterprise or not followed.

**Level 1**

- Informal documentation of business drivers for use of geospatial approaches, data, and technology
- Geospatial technology standards and best practices informal and inconsistent

**Level 2**

- Identified drivers to justify the use of Geospatial approaches, data, and technology in business operations
- Need identified for a repository to store and disseminate geospatial technology standards and best practices for geospatial information

**Level 3**

- Documentation of business drivers and strategic information related to justify the use of geospatial approaches, data, and technology leads to an inventory of needs related to standards and best practices
- Consistent use of existing geospatial technology standards within the enterprise

**Level 4**

- Documentation of business drivers and strategic information to justify use of geospatial approaches, data, and technology is a standard operating procedure

- Documentation and use of geospatial standards and best practices is relatively common in enterprise.
- Metrics used to identify need for updates to the geospatial components of business information and impact of technology on protocols, and migration / evolution strategies for implementation planning.

**Level 5**

- Documentation of business drivers and strategic information to justify use of geospatial approaches, data, and technology is a standard operating procedure
- Enterprise business and technology requirements reviewed in tandem with the monitoring of new geospatial technology and business trends to proactively identify those technologies that will improve the national geospatial framework of data, technologies, and information.
- Enterprise routinely works with and shares best practice information with multiple levels of government
- Enterprise routinely works with multiple levels of government to share information regarding general approaches to support the implementation of new geospatial business and technology trends, standards, and best practices.

### 8.1.8 GIMM Category—Training & Skills Development

**Level 0**

- No awareness of how geospatial approaches, data, and technologies benefit the enterprise
- No program for geospatial awareness education.

**Level 1**

- Need to inform the enterprise of the benefits associated with geospatial approaches and a geospatially enabled enterprise architecture identified.
- Informal and inconsistent efforts to increase geospatial awareness

**Level 2**

- Plans developed to increase the awareness and understanding of how a spatially enabled enterprise benefits the organization
- Geospatial concepts and functionalities more consistently introduced in day-to-day meetings

**Level 3**

- Management briefings create champions for geospatial integration efforts
- Mechanisms to include geospatial awareness training/promotion within planning and budgeting efforts developed
- Staffs understand and promote geospatial approaches, data, and technologies to help meet requirements for lines of business.
- Geospatial operations begin functioning as a team, using the defined architecture program and adopted / adapted geospatial standards.

**Level 4**

- Ongoing promotion of geospatial approaches, data , and technologies integrated into all operations

- Personnel throughout enterprise understand geospatial approaches and leverages them in projects across the enterprise
- Metrics measure the awareness, participation, acceptance and satisfaction with the geospatial integration effort

**Level 5**

- Partnerships with multiple levels of government to actively promote and deploy geospatial education, information, application and service support across the national geospatial enterprise.
- Interagency partnerships to spatially enabled architecture and its shared services forged.
- Metrics used to proactively create action plans for the further expansion of geospatial applications into the business of the enterprise and with external partners.

# Appendix A: References


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# Appendix B: Glossary

**Bathymetry**—the measurement of the depth of bodies of water.

**Block group**—the name for a subdivision of a census tract. A census tract is a small, relatively permanent statistical subdivision of a county or statistically equivalent entity, delineated for data presentation purposes by a local group of census data users or the geographic staff of a regional census center in accordance with U.S. Census Bureau guidelines. The block group is the lowest-level geographic entity for which the U.S. Census Bureau tabulates sample data from a decennial census.

**Cadastral data**—the data representing the cadastre.

**Cadastre**—a public record, survey, or map of the value, extent, and ownership of land as a basis of taxation.

**Component**—a reusable program building block that can be combined with other components across a distributed network to form an application. See also Service Component. (FEA Enterprise Architecture Glossary Of Terms[42])

**Coverage**—feature that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain. Examples include a raster image or a digital elevation model or a satellite image. See also Feature (ISO 19123:2005(E))

**Dataset**—identifiable collection of data (ISO 19113:2002(E)

**Dataset Series**—collection of datasets sharing the same product specification (ISO 19113:2002(E)

**Feature**—abstraction of real world phenomena (ISO 19101:2002(E))

**Geocoding**—the process of identifying the geographic location of a postal address—a subset of georeferencing

**Geodetic control**—Geodetic control surveys are usually performed to establish a basic control network (framework of known point locations) from which supplemental surveying and mapping work is performed. Geodetic network surveys are distinguished by use of redundant, interconnected, permanently monumented control points that comprise the framework for the National Spatial Reference System (NSRS) or are often incorporated into the NSRS.

**Geographic Information System**—a system for the storage, retrieval, analysis, display and maintenance of geographic information

**Georeferencing**—the process of identifying the geographic location of a piece of information. (the most common example is finding the latitude and longitude of a postal address, which is usually called geooding—a subset of georeferencing)

**Geospatial Data**—data with implicit or explicit reference to a location relative to the Earth (Adapted from ISO 19118:2005(E))

[42] http://colab.cim3.net/cgi-bin/wiki.pl?Enterprise_Architecture_Glossary_Of_Terms

**Geospatial Information**—information concerning phenomena implicitly or explicitly associated with a location relative to the Earth (Adapted from ISO 19101:2002(E))

**Geospatial Information System**—information system dealing with information concerning phenomena associated with location relative to the Earth (Adapted from ISO 19101:2002(E))

**Geospatial Service**—service that transforms, manages, or presents [geospatial] information to users (Adapted from ISO 19101:2002(E))

**Geospatial Service Component**—A Service Component (component or service) that has geospatial data or information as a primary input and/or output. (See Component and Geospatial Service).

**Hydrography**—the scientific description and analysis of the physical conditions, boundaries, flow, and related characteristics of the earth's surface waters. Hydrographic data typically refers to the boundaries of water bodies.

**Line of Sight**—the indirect or direct cause-and-effect relationship from a specific IT investment to the processes it supports, and by extension, the customers it serves and the mission-related outcomes it contributes to.

**Metadata**—data about data (ISO 19115:2003(E))

**Orthoimage**—a georeferenced image prepared from a perspective photograph or other remotely-sensed data in which displacement of objects due to sensor orientation and terrain relief have been removed. It has the geometric characteristics of a map and the image qualities of a photograph.

**Orthorectification**—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 can not be made.

**Patterns**—unique combinations of architectural or design elements (e.g. processes, components, etc.) that have proven to be useful in solving recurring architectural or design problems. The naming and reuse of patterns forms the basis of a vocabulary for communicating past experience between architects and designers. (FEA Enterprise Architecture Glossary Of Terms)

**Product Specification**—description of a universe of discourse and a specification for mapping the universe of discourse to a dataset (ISO 19113:2002(E))

**Register**—set of files containing identifiers assigned to items with descriptions of the associated items (ISO 19135:2005(E), adapted from ISO/IEC 11179)

**Registry**—information system on which a register is maintained (ISO 19135:2005(E), adapted from ISO/IEC 11179)

**Shared Service**—a form of "internal outsourcing," enables corporations to achieve economies of scale by creating a separate internal entity within the company to perform specific services, such as payroll, accounts payable, travel and expense processing. A typical shared services initiative takes advantage of enterprise applications and other technological developments, enabling the company to achieve further improvements to quality in processes, such as finance, accounting, procurement, IT, and human resources. At the core of shared services is the idea that new technologies offer

businesses the opportunity to 1) make better use of scarce skills, 2) provide information and services more efficiently, and 3) reduce the cost of administration. See also Service. (FEA Enterprise Architecture Glossary Of Terms)

**Service**—1) a specific type of component that is explicitly intended to be shared and reused by multiple applications, either internal or external to the organization. (FEA Enterprise Architecture Glossary Of Terms), or 2) distinct part of the functionality that is provided by an entity through interfaces (ISO19119:2005 (E))

**Service Component**—Modularized service-based applications that package and process together service interfaces with associated business logic into a single cohesive conceptual module. Aim of a Service Component is to raise the level of abstraction in software services by modularizing synthesized service functionality and by facilitating service reuse, service extension, specialization and service inheritance. See also Component and Service.

**Service-Oriented Architecture (SOA)**— a way of designing a system to provide services to either end-user applications or other services through published and discoverable interfaces. In many cases, services offer a better way to expose discrete business functions, and therefore, an excellent way to develop applications that support business processes. (FEA Enterprise Architecture Glossary Of Terms)

# Appendix C: FEA Overview

This overview text is quoted directly from the FY07 Budget Formulation FEA Consolidated Reference Model Document[43] and is provided as a convenient reference for the reader.

The FEA consists of a set of interrelated "reference models" designed to facilitate cross-agency analysis and the identification of duplicative investments, gaps and opportunities for collaboration within and across agencies. Collectively, the reference models comprise a framework for describing important elements of the FEA in a common and consistent way.

Through the use of this common framework and vocabulary, IT portfolios can be better managed and leveraged across the federal government. This appendix introduces the purposes and structures of the five FEA reference models:

- Performance Reference Model (PRM)
- Business Reference Model (BRM)
- Data Reference Model (DRM)
- Service Component Reference Model (SRM)
- Technical Reference Model (TRM)

## Performance Reference Model (PRM)

The PRM is a framework for performance metrics providing common output measurements throughout the federal government. It allows agencies to better manage the business of government at a strategic level, by providing a means for using an agency's enterprise architecture to measure the success of IT investments and their impact on strategic outcomes. The PRM accomplishes these goals by establishing a common language by which agency enterprise architectures can describe the outputs and measures used to achieve program and business objectives. The model articulates the linkage between internal business components and the achievement of business and customer-centric outputs. Most importantly, it facilitates resource-allocation decisions based on comparative determinations of which programs and organizations are more efficient and effective. The PRM focuses on three main objectives:

- Help produce enhanced performance information to improve strategic and daily decision-making
- Improve the alignment and better articulate the contribution of inputs to outputs, thereby creating a clear "line of sight" to desired results
- Identify performance improvement opportunities that span traditional organizational structures and boundaries

The PRM structure is designed to clearly express the cause–and-effect relationship between inputs and outputs. This "line of sight" is articulated through the use of the Measurement Area, Category, Grouping, and Indicator hierarchy. Refer to Figure 11 for the PRM structure.

[43] http://www.whitehouse.gov/omb/egov/documents/CRM.PDF

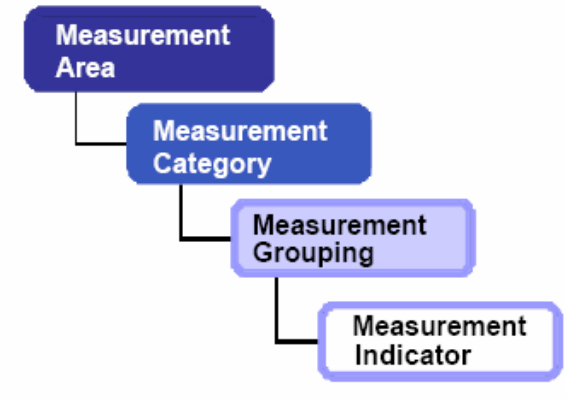



**Figure 11: PRM Structure**

## Business Reference Model (BRM)

The BRM provides a framework that facilitates a functional (rather than organizational) view of the federal government's lines of business (LOBs), including its internal operations and its services for citizens, independent of the agencies, bureaus and offices that perform them. The BRM describes the federal government around common business areas instead of through a stove-piped, agency-by-agency view. It thus promotes agency collaboration and serves as the underlying foundation for the FEA and E-Gov strategies.

While the BRM does provide an improved way of thinking about government operations, its true utility as a model can only be realized when agencies effectively use it. The functional approach promoted by the BRM will do little to help accomplish the E-Gov strategic goals if it is not incorporated into business-focused enterprise architectures and the management processes of federal agencies and OMB.

The BRM is structured into a tiered hierarchy representing the business functions of the federal government. Refer to Figure 12 for the BRM tiered hierarchy.

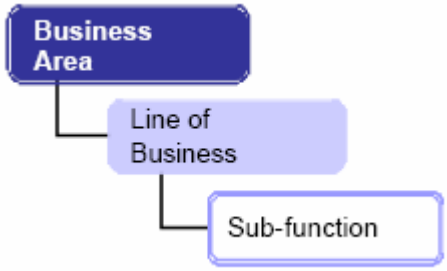



**Figure 12: BRM Structure**

## Data Reference Model (DRM)

The FEA Data Reference Model (DRM) is intended to promote the common identification, use, and appropriate sharing of data/information across the federal government through its standardization of data in the following three areas: data context, data sharing, and data description (refer to Figure 13).

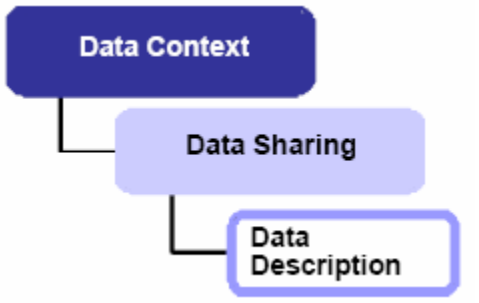



**Figure 13: DRM Structure**

The current published version of the DRM is undergoing revision. The FEA PMO is collaborating with members of the interagency DRM working group, chartered by the Architecture and Infrastructure Committee (AIC) of the Chief Information Officer (CIO) Council, to further enhance and improve this reference model. The DRM structure presented in Figure 13 is the updated description of the DRM based on the work being done by the FEA PMO and the interagency DRM working group. Because the new version of the DRM has not been completed, the latest published version is provided in this document for reference.

## Service Component Reference Model (SRM)

The SRM is a business-driven, functional framework classifying Service Components according to how they support business and performance objectives. It serves to identify and classify horizontal and vertical Service Components supporting federal agencies and their IT investments and assets. The model aids in recommending service capabilities to support the sharing of business components and services across the federal government.

The SRM is organized across horizontal service areas, independent of the business functions, providing a leverage-able foundation for sharing of applications, application capabilities, components, and business services. It is structured hierarchically as depicted in Figure 14.

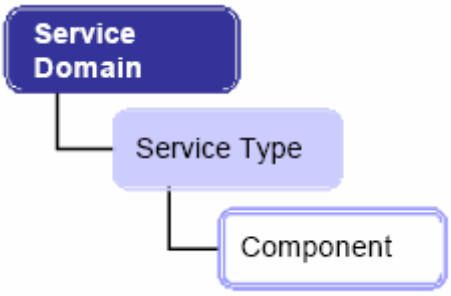



**Figure 14: SRM Structure**

## Technical Reference Model (TRM)

The TRM is a component-driven, technical framework that categorizes the standards and technologies to support and enable the delivery of Service Components and capabilities. It also unifies existing agency TRMs and E-Gov guidance by providing a foundation to advance the sharing and standardization of technology and Service Components from a government-wide perspective.

Aligning agency capital investments to the TRM leverages a common, standardized vocabulary, allowing interagency discovery, collaboration, and interoperability. Agencies and the federal government will benefit from economies of scale by identifying and reusing the best solutions and technologies to support their business functions, mission, and target architecture. The TRM structure is depicted in Figure 15.

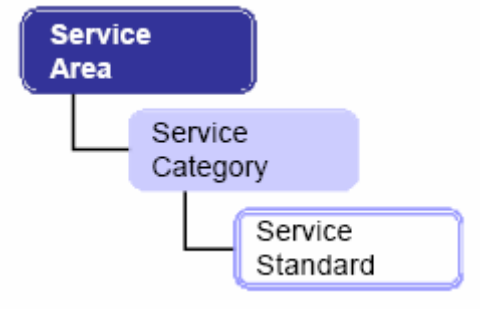



**Figure 15: TRM Structure**

## Geospatial Profile and the FEA Reference Models

This section provides a synopsis of the way the Geospatial Profile interacts with each of the five FEA reference models. For further information, please read the section indicated for each model.

- Performance Reference Model (PRM, Chapter 3)—In the geospatial view of the PRM, the discussion focuses on providing enterprise architects with support to the development of their performance architecture by discussing the potential performance measures related to geospatial IT investments.
- Business Reference Model (BRM, Chapter 4)—In the geospatial view of the BRM, the discussion centers around how geospatial data and capability participate in the elements of the FEA BRM (lines of business and sub-functions) and provides specific examples of business functions that would use geospatial under each line of business.
- Data Reference Model (DRM, Chapter 5)— In the geospatial view of the DRM, the discussion provides the enterprise architect with a context of how the geospatial community views the elements of the FEA DRM and the mechanisms used by the geospatial community to implement the FEA DRM in practice.
- Service Component Reference Model (SRM, Chapter 6)—In the geospatial view of the SRM, the discussion centers on providing the enterprise architect with an extension of the FEA SRM to include geospatial specializations of the Service Components.
- Technical Reference Model (TRM, Chapter 7)—In the geospatial view of the TRM, the discussion provides the enterprise architect with an extension of the FEA TRM to include geospatial technology standards.

# Appendix D: Geospatial Profile Use Case and Scenarios

## Scope and Purpose

This appendix provides business and functional context to the FEA Geospatial Profile by introducing a use case and scenarios that illustrate how this profile can support interoperability and data re-use across agencies and levels of government. The information provided in this appendix is a) the use case and scenario descriptions and b) background on the lines of business related to the use case. The example applications are found within the Business, Data, Services, and Technology and Standards chapters.

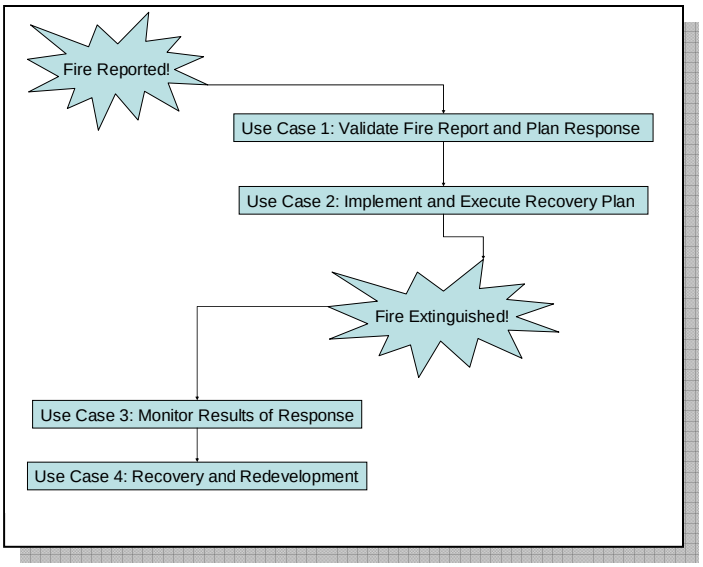
## Use Case Description

### Name:

Wildfire planning, response, and recovery.

### Description

This use case brings together several scenarios might contribute to an overall view of the planning and preparation for and response to a major wildfire event. It is intended only for illustrative purposes within this geospatial profile and thus does not consider all possible use cases.




### Pre-condition

This use case contemplates the following pre-conditions:

- A National Spatial Data Infrastructure exists that includes the ability to find and access geospatial data holdings (public and for official use only) of all involved Federal, State, Local, and Tribal government entities.
- A wildfire event is occurring that threatens life and property in the dry southwestern region of the United States.

### Basic Course of Events

- Use Case 1—Validate Fire Report and Plan Response
    - Scenario 1.1: Use fire INCIDENT REPORT to create an EVENT record, which may include who reported the fire, description of current state of the fire (e.g. size, fire behavior), on-scene resources, and responding resources, location, date and time reported, and, if known, possible cause of fire.

- Scenario 1.2: Determine if the INCIDENT REPORT constitutes a wildfire and to determine if it is within our protection JURISDICTION.
- Scenario 1.3: Make an EMERGENCY DECLARATION and deliver NOTICES to alert parties with fire protection JURISDICTION.
- Scenario 1.4: Identify and record short/long-range forecasts and current conditions relating to WEATHER and relevant environmental factors.
- Scenario 1.5: Identify public expectations in regard to protection of natural resources and developments (e.g. bridges, subdivisions, threatened and endangered species, old-growth forests, etc.) to identify any IMPEDIMENTS (e.g. road closures, airspace restrictions etc.) to the ability to perform wildfire activities.
- Scenario 1.6: Develop incident RESPONSE PLAN using information gathered above including AREA OF INTEREST, boundaries, objectives, constraints, and scope of response. This will be comprised of ACTIVITIES. Generate USER-SPECIFIC OPERATING PICTURE(S) for VISUALIZATION operations.
- Scenario 1.7: Create and deliver NOTICES and/or SITUATION REPORTS relating to RESPONSE PLAN to affected parties, cooperators, public service and regulatory organizations, and interested parties to inform them of ACTIVITIES of interest to them because of their PROXIMITY to the EVENT, their involvement in special interest groups, or their possible future participation in the EVENT, media interests, etc. These NOTICES or SITUATION REPORTS may trigger external regulatory agencies to react, e.g. the health department may send an inspector if catering service is planned.)

- Use Case 2—Implement and Execute RECOVERY PLAN
  - Scenario 2.1: Identify the ACTIVITIES to be performed and to determine the type of resources needed to accomplish the tasks. Determine current status and LOCATION of resources needed to accomplish the RESPONSE PLAN tasks.
  - Scenario 2.2: Update NOTICES, SITUATION REPORTS, and SITUATION AWARENESS information in preparation for the performance of assigned ACTIVITIES (e.g. road closures, air space restrictions, etc.). Execute those ACTIVITIES in the RECOVERY PLAN.
  - Scenario 2.3: Use and record environment OBSERVATION information and SITUATION AWARENESS information to develop an AFTER ACTION REPORT which documents the results of the RECOVERY PLAN in regards to vegetative state, species conditions, hazards, lift air space restrictions, etc.
  - Scenario 2.4: Develop an AFTER ACTION REPORT which documents other incidents that occur while implementing the RECOVERY PLAN (e.g. accidents, etc.) and document additional information about the status of the incident. Update resource status. Send AFTER ACTION REPORT to public service and regulatory organizations within the accident response JURISDICTION.
  - Scenario 2.5: Engage in PUBLIC INFORMATION OUTREACH. Send AFTER ACTION REPORT to management, cooperators, interested parties and affected parties to keep them informed of the action taken during the response and request status.

- Use Case 3—Monitor Results of Response
  - Scenario 3.1— Use AFTER ACTION REPORT as a baseline to develop a system to MONITOR RECOVERY.

- Scenario 3.2—VISUALIZE ecology/habitat change and MONITOR ongoing impacts in regards to vegetative state, species conditions, hazards, etc.

- Use Case 4—Redevelopment and Recovery
  - Scenario 4.1—Identify impacted areas for redevelopment.
  - Scenario 4.2—Identify/apply to relevant aid programs.
  - Scenario 4.3—MONITOR economic and environmental recovery.

## Background—Scenario Lines of Business

This section includes background on the following lines of business related to the use case:

- **Community and Social Services**—includes all activities aimed at creating, expanding, or improving community and social development, social relationships, and social services in the United States.
  - **Homeownership Promotion** includes activities devoted to assisting citizens interested in buying homes and educating the public as to the benefits of homeownership. NOTE: Activities devoted to the provision of housing to low-income members of the public are located in the Housing Assistance Sub-Function.
  - **Community and Regional Development** involves activities designed to assist communities in preventing and eliminating blight and deterioration, assist economically distressed communities, and encourage and foster economic development through improved public facilities and resources.
- **Disaster Management**—involves the activities required to prepare for, mitigate, respond to, and repair the effects of all disasters, whether natural or manmade.
  - **Disaster Monitoring and Prediction** involves the actions taken to predict when and where a disaster may take place and communicate that information to affected parties. Note: Weather forecasting, while central to Disaster Monitoring and Prediction, is more closely aligned with the "Environmental Monitoring and Forecasting" sub-function in the Environmental Management line of business.
  - **Disaster Preparedness and Planning** involves the development of response programs to be used in case of a disaster as well as pre-disaster mitigation efforts to minimize the potential for loss of life and property. This involves the development of emergency management programs and activities as well as staffing and equipping regional response centers, and mitigation focused construction and preparation.
  - **Disaster Repair and Restore** involves the cleanup and restoration activities that take place after a disaster. This involves the cleanup and rebuilding of homes, buildings, roads, environmental resources, or infrastructure that may be damaged due to a disaster.
  - **Emergency Response** involves the immediate actions taken to respond to a disaster. These actions include, but are not limited to, providing mobile telecommunications, operational support, power generation, search and rescue, and medical life-saving actions.[44]"

[44] OMB, *FY07 Budget Formulation: FEA Consolidated Reference Model Document*, May, 2005.

- **Environmental Management**—includes all functions required to monitor the environment and weather, determine proper environmental standards and ensure their compliance, and address environmental hazards and contamination..
  - **Environmental Monitoring and Forecasting** involves the observation and prediction of environmental conditions. This includes but is not limited to the monitoring and forecasting of water quality, water levels, ice sheets, air quality, regulated and non-regulated emissions, as well as the observation and prediction of weather patterns and conditions.
  - **Environmental Remediation** supports the immediate and long-term activities associated with the correcting and offsetting of environmental deficiencies or imbalances, including restoration activities.
- **Health**—involves federal programs and activities to ensure and provide for the health and wellbeing of the public. This includes the direct provision of health care services and immunizations as well as the monitoring and tracking of public health indicators for the detection of trends and identification of widespread illnesses/diseases. It also includes both earned and unearned health care benefit programs.
  - **Population Health Management and Consumer Safety** assesses health indicators and consumer products as a means to protect and promote the health of the general population. This includes monitoring of health, health planning, and health management of humans, animals, animal products, and plants, as well as tracking the spread of diseases and pests. Also includes evaluation of consumer products, drug, and foods to assess the potential risks and dangers; education of the consumer and the general population; and facilitation of health promotion and disease and injury prevention.
  - **Health Care Administration** assures that federal health care resources are expended effectively to ensure quality, safety, and efficiency. This includes managing health care quality, cost, workload, utilization, and fraud/abuse efforts.
  - **Health Care Research and Practitioner Education** fosters advancement in health discovery and knowledge. This includes developing new strategies to handle diseases; promoting health knowledge advancement; identifying new means for delivery of services, methods, decision models and practices; making strides in quality improvement; managing clinical trials and research quality; and providing for practitioner education.
- **Public Affairs**—involve the exchange of information and communication between the federal government, citizens and stakeholders in direct support of citizen services, public policy, and/or national interest.
  - **Customer Services** supports activities associated with providing an agency's customers with information regarding the agency's service offerings and managing the interactions and relationships with those customers.
  - **Official Information Dissemination** includes all efforts to provide official government information to external stakeholders through the use of various types of media, such as video, paper, web, etc.

# Appendix E: Geospatial Activity Examples for FEA BRM Lines of Business

| Business Area | Lines of Business | Whether Geospatial Data or Services is a Primary or Secondary Element—Line of Business Description | Example Activities Using Location-based Approaches |
|---|---|---|---|
| Services for Citizens | Homeland Security | Primary—protecting the nation against terrorist attacks. This includes analyzing threats and intelligence, guarding borders and airports, protecting critical infrastructure, and coordinating responses to emergencies | Training exercises<br>Assessment of and planning for areas of vulnerability<br>Conduct response operations.<br>Tracking potential suspects<br>Monitoring border areas. |
| Services for Citizens | Intelligence Operations | Primary—collecting and analyzing information to meet the national security challenges of the U.S. by processing reliable, accurate foreign intelligence, and disseminating intelligence products to policymakers, military commanders, and other consumers | Planning operations in areas of potential conflict<br>Conduct assessments of threat<br>Integrating information from multiple sources<br>Tracking movements of groups of individuals who may be targets for international terrorist threats |
| Services for Citizens | Defense & National Security | Primary—involves information to understand the needs for where to establish national and multinational military objectives; sequence initiatives; define limits and assess risks for the use of military and other instruments of national power; developing global plans or theater war plans to achieve these objectives. | Developing a common operating picture of an area<br>Planning troop operations and movements<br>Determine optimal logistics supply routes<br>Monitor opposition forces |

| | | | |
|---|---|---|---|
| | | | Provide assistance to civilian populations to minimize risk from threats. |
| Services for Citizens | International Affairs and Commerce | Primary - the non-military activities that promote U.S. policies and interests beyond our national borders, including the negotiation of conflict resolution, treaties, and agreements. Also includes: foreign economic development and social/political development; diplomatic relations with other nations; humanitarian, technical and other developmental assistance to key nations; and global trade | Identify factors contributing to conflict and seeking resolution,<br>Identifying areas with need for foreign economic development assistance<br>Address social/ political development priority needs in regions of the world.<br>Maintain knowledge of borders of nations and of trans-boundary issues.<br>Assessing natural resource and/or economic conditions which might impact negotiation of treaties<br>Producing maps to enhance foreign policy analysis |
| Services for Citizens | Disaster Management | Primary—involves information to conduct the activities required to prepare for, mitigate, respond to, and repair the effects of all disasters, whether natural or manmade regardless of where the threat may come from or the disaster may occur. | Tracking deployment of resources<br>Tracking distribution/location of evacuees<br>Targeting and setting priorities for monitoring and response activities<br>Status of infrastructure operations<br>Providing an overview of damage to natural and manmade entities.<br>Routing for the dispatch of emergency vehicles for emergency response<br>Delineating areas which are more susceptible to regional natural hazard |

| | | | |
|---|---|---|---|
| | | | events |
| Services for Citizens | Law Enforcement | Primary—activities to protect people, places, and things from criminal activity resulting from non-compliance with U.S. laws. This includes patrols, undercover operations, response to emergency calls, as well as arrests, raids, and seizures of property. | Crime tracking<br>Pattern-based Crime prediction (e.g. analysis<br>of the relationship between newly developed transportation corridors and increases in crime rate).Deployment of enforcement resources to maximize effectiveness<br>Connecting information from different departments to create a bigger picture |
| Services for Citizens | Education | Primary—Activities for all government programs that promote the education of the public, including formal school, college, university or other training program at any location. | Tracking of results of programs<br>Geographically displaying and analyzing school performance, trends, and corrective actions taken<br>Tracking of resources by district<br>Tailoring programs based on demographics<br>Determine boundaries for schools<br>Developing school buses routes |
| Services for Citizens | Energy | Primary—all actions performed by the government to ensure the procurement and management of energy resources, including the production, sale and distribution of energy, as well as the management of spent fuel resources. | Siting for man made facilities such as power plants<br>Overview of location of natural resources such as coal, oil, and natural gas deposits.<br>Determination of transportation facilities such as power line, pipelines and railroads |

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| | | | Determination of impacts of energy operations and risks due to natural events such as weather<br><br>Tracking of materials, both hazardous and nontoxic<br><br>Tracking release and dispersion of fissile material and radioactive material<br><br>Modeling and monitoring pipelines |
| Services for Citizens | Environmental Management | Primary—all functions required to monitor the environment and weather, determine proper environmental standards and ensure their compliance, and address environmental hazards and contamination. | Assessment of ecological impacts from development Monitoring air, and water , quality and determining impact on specific populations<br><br>Determining levels of pollutants release from a hazardous materials spill and predicting impacts upon humans as well plant and animal species<br><br>Predicting future air quality levels for transportation corridors based on differing emission standards<br><br>Setting priorities for, monitoring, permitting, inspections, compliance assurance activities, enforcement etc.<br><br>Designing monitoring networks<br><br>Characterizing populations around hazardous release sites and/or stacks/outfalls and to protect potentially sensitive sub populations<br><br>Monitoring environmental restoration and clean up |

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| Services for Citizens | Health | Primary—federal programs and activities to ensure and provide for the health and wellbeing of the public including the direct provision of health care services and immunizations as well as the monitoring and tracking of public health indicators for the detection of trends and identification of widespread illnesses/diseases | Monitoring emergent infectious diseases or outbreaks of disease and their spread<br>Planning for the distribution of vaccines to meet needs of aging or young populations<br>Determining the distribution of medical personnel in an area to meet the needs of populations<br>Planning for the location of medical facilities to take advantage of transportation routes<br>Studying historical health trends to understand potential future issues |
| Services for Citizens | Natural Resources | Primary—all activities involved in conservation planning, land management, and national park/monument tourism that affect the nation's natural and recreational resources, both private and federal | Establishing and managing outdoor recreational areas<br>Planning and managing timber production and economic effects on nearby communities.<br>Assessing the biological health of wildlife populations and developing management plans for species which may be at risk<br>Collecting and maintaining basic mapping data for use in all government and services programs<br>Conducting seeding, replanting or other rehabilitation actions after wild land fires<br>Analyzing and defining areas suitable for development and others more suitable for conservation |

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| Services for Citizens | Community and Social Services | Primary—information about location for activities aimed at creating, expanding, or improving community and social development, social relationships, and social services in a community in the United States. This includes all activities aimed at locality-specific or nationwide social development and general social services. | Planning the level of social services which are needed by communities<br>Determining underserved communities and providing facilities and services to meet needs<br>Monitoring impact of programs on the health or educational achievement of communities<br>Identifying locations in need of after school facilities<br>Planning maintenance and upgrade of playgrounds and community recreational facilities. |
| Services for Citizens | Economic Development | Primary—information to know where to promote commercial/industrial development and to regulate the American financial industry to protect investors nationally. It also includes the management and control of the domestic economy and the money supply, and the protection of intellectual property and innovation across the nation. | Planning Rural Development programs based on community needs<br>Planning for and stimulating the recovery of business affected by natural disasters<br>Developing a picture of the flow of commerce domestically and its economic effects<br>Identifying areas which can benefit most from commercial and industrial development |
| Services for Citizens | General Science and Innovation | Secondary—all federal activities to meet the national need to advance knowledge in general research and technology programs, space exploration activities, and other research and technology programs that have diverse goals | Understanding the research capabilities for different geographic areas of the nation<br>Coordinating research activities to share results |

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| | | | Supporting the establishment of research priorities |
| Services for Citizens | Correctional Activities | Secondary—federal activities that ensure the effective incarceration and rehabilitation of convicted criminals | Making site selection decisions for the placement of new facilities within a community.<br>Identifying areas prone to inmate violence in institutional settings<br>Assigning probation and parole officers by geographic location;<br>Directing probationers and parolees to services and treatment centers;<br>Identifying Patterns of offenders and targeting efforts to high-risk areas,<br>Tracking probationers in terms of risk and need for resources. |
| Services for Citizens | Litigation and Judicial Activities | Secondary—activities relating to determining an issue of fact and reaching a decision based on that evidence, determining a legal question or matter or attempting to prove guilt/responsibility | Monitoring compliance and required public notification<br>Tracking and enforcing land use controls by red-flagging properties that have residual contamination after cleanup.<br>Mapping the physical situation on the ground immediately after a spill or the air after a release to prove liability<br>Analyzing demographics for civil rights actions |
| Services for Citizens | Income Security | Secondary—activities designed to ensure that members of the public are provided with the necessary means – both financial and otherwise – to sustain an adequate level of existence. This | Targeting programs to benefit the poor – households ( income generation, health, housing, and sanitation) |

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| | | includes all benefit programs, hat promote these goals for members of the public | Estimating extent of poverty in a regions / Mapping where the poor live and/or regions with less potential for economic<br>development to help target resource allocation<br>Planning and targeting infrastructure programs<br>Analyzing the spatial relationships between the providers' infrastructures/ public service centers and the clients' locations to help optimize the delivery of services<br>Providing detailed demographic and business information for strategic planning<br>Codifying objective criteria for needed geographic distribution of assistance |
| Services for Citizens | Workforce Management | Secondary—those activities that promote the welfare of the nation's workforce by improving their working conditions, advancing opportunities for profitable employment, and strengthening free collective bargaining | Providing view of where workers are located, the work being performed, and what resources are needed<br>Analyze clusters of jobs and workers<br>Determining if a proposed public transportation will connect workers to jobs<br>Targeting recruitment efforts<br>Designing facilities /work spaces to optimize worker needs |

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| Services for Citizens | Transportation | Primary—all federally supported activities related to the safe passage, conveyance, or transportation of goods and/or people including air, ground, water and space operations | Evaluation of a proposed roadway or other transportation /transmission corridors<br><br>Planning for long term infrastructure development and/or short term projects (e.g. Which potholes to fill next).<br><br>Identify highway deficiencies and applies economic criteria to select the most cost-effective mix of highway system improvements.<br><br>Summarizing freight movement trends in the U.S.<br><br>Evaluating the scope and performance of the transportation system |
| Support Delivery of Services | Legislative Relations | Secondary—activities aimed at the development, tracking, and amendment of public laws through the legislative branch of the federal government | Assessing regional impacts/benefits of proposed and existing legislation<br><br>Tracking the implementation of public laws<br><br>Assessing public support for proposed legislation over regions, states, districts etc.<br><br>Assessing conditions that would support the passage of legislation |
| Support Delivery of Services | Regulatory Development | Secondary—involves activities associated with developing regulations, policies, and guidance to implement laws | Assessment of economic impacts in specific areas related to implementation of proposed regulations<br><br>Assessment of level of chemicals in waterways, air etc to determine need for regulation |

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| | | | Providing visualization to regulated community on applicability of laws and compliance requirements |
| Support Delivery of Services | Public Affairs | Secondary—the exchange of information and communication between the federal government, citizens and stakeholders in direct support of citizen services, public policy, and/or national interest | Outreach to potential applicants for assistance in underserved areas or among populations.<br>Informing local and state legislators<br>Ensuring environmental justice<br>Providing the public access to information about their neighborhoods<br>Communicating about natural/manmade disasters<br>Summarizing alternatives in public meetings<br>Providing travelers to public sites ability to plot their course for visits<br>Providing easy access to information , thus reducing need to travel into a government center/office |
| Support Delivery of Services | Planning and Resource Allocation | Secondary—the activities of determining strategic direction, formulating and executing budgets, identifying and establishing programs for defining and allocating the organizational workforce and technology requirements among those programs and processes | Targeting of funding decisions to maximize their effectiveness<br>Planning for deployment of emergency assistance resources<br>Identification of the crew in closest proximity to a new, urgent work site for optimal dispatching.<br>Tracking distribution of grants and contracts, and assets |

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| Support Delivery of Services | Revenue Collection | Primary—includes the collection of government income from all sources. Except for tax collection which is accounted for in General Government | Evaluation of patterns of loan delinquencies<br>Evaluation of distribution of publication sales by region |
| Support Delivery of Services | Internal Risk Management and Mitigation | Primary—all activities relating to the processes of analyzing exposure to risk in the event of a catastrophic or damaging event and determining appropriate countermeasures | Assessment of health, environmental or economic risk from environmental or economic hazards in specific areas or of specific projects<br>Targeting areas for preventive activities<br>Managing deployment of resources to mitigate risks.<br>Evaluating effectiveness of risk planning and countermeasure after event occurs |
| Support Delivery of Services | Controls & Oversight | Primary—operations and programs of the federal government and its external business partners determine the effectiveness of and the extent to which they comply with applicable laws and regulations and prevent waste, fraud, and abuse | Identifying geographic patterns of fraud or identification of waste or fraud by a single entity across similar geographic areas.<br>Targeting compliance and/or enforcement actions<br>Evaluating effectiveness of control measures |
| Support Delivery of Services | General Government | Primary—general overhead costs of the federal government, including legislative and executive activities; provision of central fiscal, personnel, and property activities; and the provision of services that cannot reasonably be classified in any other line of business. Includes Tax Collection | Tracking resource distribution and use ,<br>Managing facilities and properties<br>Tracking real estate transactions that take place<br>Gathering organizing and analyzing information on properties |

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| Management of Government Resources | Financial Management | Secondary—The use of financial information to measure, operate and predict the effectiveness and efficiency of an entity's activities in relation to its objectives. The ability to obtain and use such information is usually characterized by having in place policies, practices, standards, and a system of controls that reliably capture and report activity in a consistent manner | Tracking and allocation of grants and/or contract dollars by state, congressional districts etc and assessing against goals. |
| Management of Government Resources | Human Resource/Resource Management | Secondary—all activities associated with the recruitment and management of personnel | Identifying locations of academic centers of excellence for targeted recruitment in relationship to recruiting personnel.<br>Tracking the distribution of workers throughout an organization's various facilities /locations<br>Comparing regional economic conditions when determining salaries to support raises and compensation packages<br>Assessments of demographics to assess deployment and/or redeployment of employees<br>Assessment of minority populations in various components of an organization |
| Management of Government Resources | Administrative Management | Primary—the day-to-day management and maintenance of the internal infrastructure. Includes the maintenance and operation of office buildings, fleets, machinery, and other capital assets; the physical protection of an organization's personnel, assets, and facilities and business related travel for an organization's employees | Managing phone/network/cubicle management; personnel rosters by facility for emergency evacuation purposes<br>Providing information on public utilities supporting government facilities. |
| Management of Government | Information and Technology | Secondary—involves the coordination of information and technology resources and systems required to support or | Identifying facility/personnel locations in planning network/bandwidth leasing |

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| Resources | Management | provide a service | |
| Management of Government Resources | Supply Chain Management | Primary—the purchasing, tracking, and overall management of goods and services | Tracking shipments of sensitive cargo; manifest tracking/management.<br>Assessing purchase patterns for future procurement<br>Maintaining inventories |

# Appendix F: Geospatial Business Language

The *Geospatial Business Language* defined herein consists of the key terminology used to define the role of geospatial in the Federal Enterprise Architecture (FEA) context. These terms are intended as a starting place for agencies to use in defining their enterprise architectures and specifically their Business Functions (see Enterprise Architecture Glossary of Terms). More than a glossary, these definitions form the basis for a consistent language, a *lingua franca* for describing the role of geospatial in all Business Functions within a Business Architecture. Further, these terms are used to construct the *Geospatial Business Statements*, which describe the role of geospatial for each of the Business Functions (See Geospatial BRM).

The *Geospatial Business Language* is comprised of five basic types of terms:

- **Application** – A computer program with a user interface or computer program component that employs geospatial data and technology; a geospatial business process or sub-process that is implemented as a software program or program component.
- **Data** – A geospatial information class, type or property.
- **Function** – A geoprocessing unit; a geoprocessing user tool; a geospatial service component.
- **Process** – A general business series of actions that employs geospatial data and technology.
- **Technology** – An application of science that generates, displays, manages or otherwise processes geospatial data. (Excluding general-purpose Information Technology.)

This appendix lists the set of geospatial business language terms that might apply within an agency Business Architecture. This list will be updated periodically to reflect changes as they become known by the GEA COP WG. Please see the following page for the most up-to-date listing:

http://colab.cim3.net/cgi-bin/wiki.pl?GeoSpatialCommunityofPractice/GeospatialBusinessLanguage

To submit a modification to this list, send an electronic mail with the Subject, "Geospatial Business Language Modification Request" to geo-forum@colab.cim3.net. In the content of the electronic mail include the following information:

- Requesting Organization—the name of the organization making the change request.
- Requesting POC Name—the name of a cognizant point of contact with the requesting organization.
- Requesting POC Telephone—the telephone number of a cognizant point of contact with the requesting organization.
- Requesting POC Email—the electronic mail address of a cognizant point of contact with the requesting organization.

- Modification Type—one of Update (to update an existing entry), Insert (to add a new entry), Delete (to delete an existing entry)
- Term—the name of the geospatial business language entry
- Type—the type of the geospatial business language entry (must be one of application, data, function, process, technology as defined above)
- Definition/Description—the definition/description for the geospatial business language entry
- Justification—text that justifies the modification requested.
- Implications—text that describes any implications of note that would result from acceptance of the modification (e.g., this change will require the deletion of another entry, the addition of another entry, or similar)

A separate Geospatial Business Language Modification Request should be made for each desired modification. All requests will be registered for processing at the next meeting of the GEA COP WG.

| Geospatial Term | Type | Definition/Description |
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| Absolute Location | Data | Specifies a precise position on the earth. Defined by an address, position, feature geometry (e.g., point, line or polygon), or Place of Interest. A subtype of Location Object. |
| Activity | Data | Any current, historical or planned event of interest with geospatial context (location/time, extent, geographic, national), or a temporal series of actions with a series of geospatial contexts. |
| Activity | Process | An agency business activity. A process or sub-process involving one or more elements of the agency enterprise architecture. |
| Activity Report | Data | Reports that contain the geospatial-temporal context of any agency function. Reports contain interlinked, multi-media data that characterize the nature, context and status of the function. |
| Activity Report Service | Technology | Able to generate an Activity Report for any location-based function. |
| Address | Data | Specifies street location, postal location or street intersection as used in navigation and locating parties and facilities. Address consists of a street address (or intersection), place name (e.g., country, municipality, etc.), postal code, street locator, building locator, and supplemental address information. Addresses are the means of referencing primarily residences and buildings (of all types). |
| After Action Report | Data | The geospatial-temporal context of post-incident/event lessons learned in location-based account form. Based upon understanding of the root cause, status of recovery and recommended actions. Detailed accounts (reports) contain interlinked, multi-media data that adequately characterize the nature and context of the incident/event. Detailed accounts (reports) may contain references to plans, maps and other reports. |
| After Action Report Service | Technology | Able to generate a detailed account (After Action Report) with the geospatial context of the root cause, status and recommendations pertaining to post-incident recovery operations. |
| Alert | Data | A communication message with geospatial and temporal context that is triggered by any suspicious or threatening event. Can be determined by evaluating observed or calculated conditions through a "watch" function, an output from a modeling and simulation activity, by correlating incidents, occurrences and/or intelligence and predicting a potential threat or threat condition. Example: A sensor alert that results from one or more observations that meet predefined 'threat detection' conditions. Alerts may lead to false alarms or develop into Warnings (as determined by a qualified party). |
| Alert-Warning Report Service | Technology | Able to generate a communication message with a detailed account (Alert-Warning Report) containing information about location-based alert or warning messages. |
| Area of Interest (AOI) | Data | A defined parameter (circle, bounding box, or polygon representing a region of concern. Generally, any area of interest within the mission. Used as a search parameter or can be displayed. A designated area of interest in an application. |
| Assessment | Data | Generally, the results of analysis pertaining to a topic of interest, such as a threat, threat consequence, risk, vulnerability, etc. The geospatial-temporal context of geospatial analysis results, which includes supporting facts, interpretations, hypotheses and projections. May consist of maps, annotated images, reports, plans, etc. |
| Asset | Data | A valuable item that is owned. Generally, any equity used in agency operations. |

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| Asset Inventory | Data | The management data associated with equities (Assets). |
| Asset Inventory Management | Application | Enterprise-level application(s) that is used to manage fixed and mobile equities (Assets). In particular, to monitor and track the location/time/identity/activity/status for a set of equities (Assets). |
| Audit Trail | Data | A history of significant geoprocessing operations. e.g., Records of geospatial database update operations (what, when, where). |
| Auxiliary Data | Data | Any geospatial information of value to the mission that are not available as Framework Data, but are directly accessible to the Enterprise Architecture through sharable external resources. Information (data) used in support of the agency mission that are available from all possible sources. Collection is triggered by significant incidents. Information (data) may not have been merged or integrated in order to conform to or be consistent with any National standards. |
| Background Check (Records) | Data | The geospatial context associated with historical analysis, examination or exploration. |
| Base | Data | The foundational data required for generating multi-purpose maps and other geospatial products. The data that comprise a Base Map. May consist of one or more features and/or coverages. All Base data should be registered to a common coordinate reference system. |
| Base Map | Data | A multi-purpose representation of the earth (or portion thereof) that conveys general geospatial context, as depicted by predominant geographic features. |
| Benefit (Records) | Data | The compensation for a party. Privileges that are granted or provided by the government. Also medical compensation (Benefits), including medical care and crisis counseling, and relief compensation (Benefits), including assistance to victims and their families for emergency relief. |
| Biographical | Data | The geospatial vita for persons (e.g., physical address, place of birth, citizenship, person/organization affiliations, residence history, travel history, etc). |
| Biographical Analysis | Application | The means to examine a person (records) in conjunction with other geospatial data, including events, person/organization affiliations, incidents, threats and intelligence data. |
| Capital Asset | Data | Capital assets are land, structures, equipment, and intellectual property (including software) that are used by the Federal Government and have an estimated useful life of two years or more. Examples include: easements, rights of way, buildings, facilities, and other structures. The geospatial records describing these assets. |
| Cargo (Records) | Data | Current, historical, and predicted location/time/identity/activity/status (e.g., tracked location, route, speed, direction, conveyance, etc.) of payload/freight/shipment/goods and their containers. Includes geospatial context of shipping manifest records (i.e., identification of organization/place of manufacture, place of shipping origin, destination, shipping route, etc.) Includes identity, location, time and status for seized cargo. Cargo locations may relate to mobile conveyances or fixed locations (cargo may be in a warehouse, pier, wharf, etc.) |
| Case (Records) | Data | Generally, all information (records) associated with an investigation. As used here, specifically the geospatial context (location/time/identity/activity/status) pertaining to an investigation. Current, historical, and predicted geospatial context (tracking) for persons, organizations, incidents, occurrences, conveyances, cargo, etc., as associated with an investigative case. Includes location/time/identity/activity/status for related confiscation and seizures of goods, assets, conveyances, etc., and current and |

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| | | historical locations associated with evidence. May reference conveyance, risk (threat), event (incident, occurrence, Event), or party (person or organization) records. |
| Case Analysis | Application | Generally the evaluation of all information (records) associated with an investigation. The means to (data) mine, integrate, and correlate varied types of case-related data for the purpose of extrapolating, analyzing and deriving geospatial data in the form of profiles, patterns, trends, networks, tendencies, indicators, hypotheses, and conclusions, as it pertains to case understanding. Source data include, but are not limited to, intelligence, incidents, occurrences, criminal and suspicious activities, financial transactions, persons, organizations, goods, cargo, hazmat, conveyances, etc. May also involve geoparsing and geocoding functions to scan and annotate associated textual data for geographic and temporal references. |
| Catalog Service | Technology | The Catalog Service defines common information models and standard operations that allow applications and services to interact with registry instances, regardless of their role or content, in order to discover, access and manage geospatial resources (data and services). Specialized Catalog Services may exist for specific data classes, e.g., an Image Catalog Service (ICS). |
| Change detection | Function(s) | The assessment of alterations to features or coverages over time to support geospatial/intelligence analysis. This is often accomplished using a time-series of imagery to identify areas or features where any detected change may have occurred. Change is characterized in the spatial-temporal domain. Change may be represented as an alteration in location, identity, activity or status. |
| Citizenship | Data (Property) | A person's country of origin or home country, as established through naturalization. |
| Collaboration | Function | The means to share information and interact with common resources (data, services and applications). [More than merely sharing data.] Involves timely dissemination of the right actionable information to actors in an operational setting, and thus depends upon interoperable communications to all parties (cross-jurisdictional) and to all operational nodes, including the field. Effective collaboration functions are optimized in terms of the duplication/distribution of shared, collaborative resources. |
| Collaboration (Geospatial) | Process | (Geospatial) collaboration refers to the process of sharing and interacting with common resources that are based on geospatial data, service and application (business) standards, supporting interoperations across all levels of government and private institutions. Collaboration is enabled by collaborative technologies that are based upon common standards for geospatial data, services and applications. |
| Collection Plan | Data | The planned schedule, tasking and resource allocations pertaining to a given assemblage asset, asset mission and set of assemblage requirements for geospatial data, imagery or intelligence. |
| Collection Requirements | Data | Requests for geospatial data (including remote sensing) and intelligence, including location and geospatial extent of collection area of interest, observables and required geospatial attributes or properties, which can then be converted into data requests for known collection methods and systems. |
| Communication | Data | Correspondence, outreach content, warnings or alerts. |
| Community of Interest (COI) | Data | A group of enterprise users who share common data, services and/or business processes. Communities of Interest (COIs) defines the semantics for sharing enterprise resources. These semantics (ontology) form the basis for achieving autonomous, robust interoperability throughout the enterprise. |
| Containment Area | Data | The geospatial extent of a target geospatial boundary to contain an incident, and the impact and consequences of the incident. |

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| Contingency Plan | Data | A program of action designed for handling possible future circumstances or events. Geospatial and temporal context for contingency plans associated with any plan or operation. |
| Conveyance (Records) | Data | A vehicle, vessel, boat, aircraft, truck, or other mode of transportation that is able to transport cargo or passengers. The records for description, tracking and monitoring of conveyances (aircraft, marine vessels, motor vehicles, trains). Includes identity (digital records of credentials, owner's address, etc.) and other tracking and monitoring information. Tracking and monitoring of conveyances produces current, historical and future (planned or projected) location/time/identity/activity/status data. These records may include travel history, travel itinerary, shipping manifest and license/permit information. May reference events (occurrences, incidents, and events), cases, persons and organizations. |
| Coordinate Reference System | Data | A function that associates locations in space to geometries of coordinate tuples in a mathematical space, usually a real valued coordinate vector space, and conversely associates coordinate values and geometries to locations in the real world, e.g., geographic coordinates (latitude, longitude) and Universal Transverse Mercator (UTM) (projected coordinates). |
| Coordinate (and Unit) Transformation Service | Technology | The ability to convert geospatial data between different coordinate reference systems, datums and units. Support map re-projections on-the-fly for map viewing, as well as permanent coordinate conversions that result in a converted output data set. |
| Common Operating Picture (COP) | Data/ Technology | The collective set of time-sensitive, mission-critical, shared resources (data and services). Contains geospatial context (a composite of Framework Data and Auxiliary Data), the disposition and nature of threat(s), friendly personnel and assets, as well as incidents, events, observations, related intelligence, and other relevant agency operations data. A COP represents a collaborative workspace for interoperations between all distributed actors in support of time-sensitive, mission-critical agency operations. It is not practical to consider a COP as merely a common data view. Rather, many possible views may be generated on the fly for a given mission and/or user (depending on associated services, available data and application context). Related to the COP, MSOP is a collaborative workspace comprised of the subset of shared COP resources that are required for a mission, with additional resources that are unique to the mission. The User-Specific Operating Picture (USOP) is an actionable data view of the MSOP that is specialized for a user, in a specific role, on a specific device. |
| COP Collaboration Server | Technology | A Collaboration Server is a computer connected to clients via a network used for hosting, managing, and monitoring shared COP/MSOP/USOP resources and the cooperative exchange of geospatial data. |
| COP Manager | Application | The means to direct or control the scope and resources associated with a COP and MSOP. The scope is defined in terms of geospatial extent (area of interest), timeframe, subject of interest (e.g., threat(s), case, monitor cargo, etc), operations objectives (e.g., respond to incident, recover from disaster, etc), the data required to support the execution of operations (e.g., support threat modeling & analysis, case analysis, cargo tracking, etc), and other operations parameters (e.g., constraints, mission features, etc). Resources may include physical entities (e.g., personnel, assets, conveyances, technology, etc) and logical entities (e.g., business components and processes, data, services). The COP Manager provides the means to select and allocate resources, manage and monitor collaboration activities, monitor status and performance of resources, and monitor and manage external communications. The distinction between the COP Manager and other operations-related applications is that the COP Manager is managing the big picture (COP), and subsets of the COP (MSOPs), whereas other agency applications focus on USOP in user-specific operations activities. |
| COP Manager Client | Technology | COP Manager provides the means to direct or control the scope and resources associated with a COP, select and allocate resources, direct and monitor collaboration activities, monitor status and performance of resources, and monitor and control external communications. The distinction between the COP Manager and other operations applications is that the COP Manager is managing |

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| | | the big picture (COP), and subsets of the COP (MSOPs). |
| Correlation (geospatial) | Process | The process of relating data through geospatial-temporal properties. |
| Coverage | Data | A two- (and sometimes three or higher) dimensional geographic representation of earth phenomena. A subtype of Feature. Common examples include imagery and digital terrain models. |
| Coverage Portrayal Service | Technology | Coverage Portrayal Service is chained to a Web Coverage Service (WCS) to convert geospatial coverage data (grid/image) to a map. The resultant map can be overlaid with data fetched from other servers for reference and orientation. |
| Critical Asset | Data | Critical infrastructures are those physical and cyber-based systems essential to the minimum operations of the economy and government. They include, but are not limited to, telecommunications, energy, banking and finance, transportation, water systems and emergency services, both governmental and private. |
| Critical Infrastructure Inventory Management | Application | The means to keep track of and report on the location and status of critical assets and key assets. To generate reports and maps conveying this information. |
| Custody (Records) | Data | The custody records for a person. |
| Damage Assessment | Application | The means to analyze and determine the extent and nature of destruction, harm, injury, and loss of value caused by a threat or natural hazard through the use of imagery and other sensor and human observations. Includes loss estimations. To generate reports and maps conveying this information. |
| Damage Assessment | Data | A map, image and/or related report that characterizes the location, extent and severity of destruction, harm, injury, and loss of value caused by a threat or hazard. |
| Data Acquisition/Generation | Application | Generally, the means to acquire, collect, process and/or generate new information (data) for the enterprise. There are many such specialized applications and tools for collecting, reformatting, verifying, editing, integrating and transforming new information (data) for the enterprise. e.g., Supervisory Control and Data Acquisition (SCADA). |
| Data Collection Management | Application | The means to submit new information (data) gathering requirements and administer these requests through fulfillment or obsolescence. Includes the means to manage requirements for human/sensor collection activities. |
| Data Collection Planning | Application | The means to devise, schedule and allocate requests for new information (data) to gather assets; to develop assembly plans that convey schedule, tasking and resource allocation for collection assets. |
| Data Correlation | Function | The family of functions for determining the spatio-temporal interrelationships and statistical correlation between data sets, and elements and properties within these sets. Correlation functions include intersection (AND, AND NOT), union (OR, NOT), proximity, statistical correlation (as it relates to accuracy and precision), pairings, regression, etc. Also the functions that determine the meanings of geospatial-temporal correlations. |
| (Geospatial) Data Dictionary | Data | A repository for well-known data terms (classes, elements, types, properties, relationships) for all data that are to be shared within a COI. The names, definition, schema fragments (format/syntax), legal values/value ranges for these terms. |
| Data Discovery Service | Technology | Able to search for and locate desired data through open, standard publish-find mechanisms. Search requests may be defined in terms of geospatial-temporal, mathematical and statistical filters for discovering data and data relationships, and optionally storing the |

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| | | metadata results as a new data set. |
| (Geospatial) Data Mining | Function | The family of search and retrieval functions that employ search filters with Boolean, mathematical (geometric and topological) and statistical operators for discovering patterns, trends, tendencies, etc. in geospatial data. |
| Decision Support Aids | Data | Artifacts used to assist in judgments. Broadly, decision support data that have geospatial properties or are defined as geospatial entity subtypes. Consists of plans, reports and maps with geospatial content. |
| Deployment Plan | Data | The procedures to bring forces, material, people, systems into operation. Geospatial and temporal context for deployment plans associated with any operation. Depicts terrain, objectives, threats, (blue & white) assets, etc. |
| Digital Rights Management Services | Technology | DRM is the use of a range of techniques to control copyright material and the terms and conditions on which it is made available to users. Digital Rights Management Services provide secure, controlled access to geospatial data provided by private providers/stewards for mission-critical agency business activities. |
| Direction | Data (Property) | The relationship by which the alignment or orientation of any position with respect to any other position is established. |
| Disaster Assistance | Application | The means to support hazard/disaster related benefits processing. To share hazards and related assessments [e.g., Digital Flood Insurance Rate Maps (DFIRMs) for lending institutions and flood insurance purposes (Human Services – Individual Assistance & Public Assistance), post disaster Housing Habitability data (individual structures and public infrastructure) for rebuilding purposes, etc.] |
| Distance | Data (Property) | A linear extent of space between two points. The travel distance between two places. |
| Electronic Navigation | Application | The use of computerized systems to track movements/shipments/conveyances/aeronautics. The means to determine, verify and simulate navigation guidance for mobile assets. To produce navigation instructions and guidance data for use in computer-assisted navigation. These need to be uploaded to conveyances (for navigation) and simulators (for mission rehearsal). Employ navigation technologies such as Long Range Radio Aid to Navigation (LORAN), Global Positioning System (GPS), digital nautical charts (National Oceanic & Atmospheric Administration (NOAA), and flight planning and management software with digital aeronautical charts (Federal Aviation Administration (FAA)), automatic vehicle locator (AVL) and in-vehicle navigation systems, and inertial navigation systems (INS). |
| Emergency Declaration | Data | The geospatial extent and nature of a serious situation or occurrence that happens unexpectedly and demands immediate action, portrayed in map and/or report form. |
| Emergency Declaration Report Service | Technology | Able to generate an Emergency Declaration Report with the geospatial extent and nature of an emergency. |
| Emergency Reporting | Application | The means to document and account in detail the nature and geospatial-temporal context of a serious situation or occurrence to proper authorities; to declare state and federal emergencies. Reference threats, threat consequence assessments, warnings, alerts and other location-based content germane to the emergency. |
| Emergency Report | Data | The geospatial-temporal context of a disaster/incident/danger/accident. A location-based detailed-account pertaining to a state or federal emergency. Reports may reference maps, mission plans, incidents, occurrences, parties, threat intelligence, |

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| | | risks/threats/vulnerabilities and associated assessments, etc. Reports contain interlinked, multi-media data that adequately characterize the nature and context of the emergency. |
| Environmental Impact Assessments | Data | The analysis of environmental data for a recovery site(s) and the examination of the impact on the external conditions and surroundings. Analysis of the effectiveness of recovery plans and operations as they pertain to safety and health concerns in a post-incident environment. |
| Evacuation Plan | Data | The documented process of departure of people from a particular location, usually due to an emergency or natural disaster. The geospatial-temporal context of the evacuation plan, which includes maps and reports that convey plan objectives, schedules and details, which includes: estimated population densities, threat locations, threat consequences, evacuation routes, mutual aid support facilities, etc. |
| Evacuation Planning & Management | Application | The means to produce and implement plans that convey the details pertaining to evacuation of a current or planned disaster/threat area. Produces Evacuation Plans. |
| Event Analysis | Application | The means to (data) mine, integrate, and correlate varied types of events (occurrences, incidents, activities) for the purpose of extrapolating, analyzing and deriving geospatial data in the form of patterns (e.g., cluster), densities, trends, networks, tendencies, indicators, hypotheses, and conclusions, as it pertains to event understanding. Source data include, but are not limited to, intelligence, incidents, occurrences, case, criminal and suspicious activities, financial transactions, persons, organizations, goods, cargo, hazmat, conveyances, etc. May also involve geoparsing and geocoding functions to scan and annotate associated textual data with geospatial-temporal references. |
| Event Plan | Data | The documented process of an organized occurrence. The results of Event Planning & Analysis for major events. The geospatial-temporal context of the event plan, which includes maps and reports that convey plan objectives, schedules and details which includes: event venue (location/time/activity), facilities, assets, personnel, security plans, evacuation plans, mutual aid support plans, etc. |
| Event Planning & Analysis | Application | The means to produce Event Plans for major events, and to examine the potential threats and vulnerabilities in context with event venue (location/time/activity), facilities, assets, personnel, security plans, evacuation plans, mutual aid support plans, etc. |
| Event (Records) | Data | Any event (incident, occurrence, or event) of interest with geospatial and temporal context. |
| Event Venue | Data | A schedule of planned activities and locations for a major event. A subtype of Event Plan. |
| Evidence | Data | The current and historical location/time/identity/status associated with the collection of individual pieces of data or artifacts associated with a case, and locations of evidence storage to ensure chain of custody. (Also see Case.) |
| Exercise Planning | Application | The means to produce accounts that convey the details pertaining to training drills for simulated threat(s) for a given area/facility/event. Produces Exercise Plans. |
| Exercise Plan | Data | The document process for drills related to training and preparation. The results of training exercise planning. The geospatial-temporal context of the plan, which includes maps and reports that convey objectives and situation context for the exercise, including: area/facility/event location detail, simulated threats, threat consequences, response objectives, asset locations, population densities, evacuation routes, mutual aid support facilities, etc. |
| Facilities | Data | Geospatial representations of surface, above surface and sub-surface structures, and installed Heating, Ventilation & Air Conditioning |

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| | | (HVAC), plumbing, electrical, security systems, and other installed infrastructure for any facility identified as an asset. Also, associated real property (e.g., rights of way, easements, etc) |
| Facility Mapping & Management | Application | The means to create and maintain detailed geospatial records of structure(s) for the purpose of managing the structure(s) and related land and infrastructure. Used in planning, construction, security and maintenance. Used to produce facility Maps, Plans and Reports. Assure compliance with all applicable laws regulating the development, use or transfer of property. These include National Environmental Policy Act (NEPA), Americans with Disabilities Act (ADA), Clean Water Act (CWA), Occupational Safety and Health Act (OSHA), Superfund Act, state and local permitting, and so on. Any planned construction activity at federally owned/operated facilities requires compliance with these laws. Used to manage space utilization of existing facilities to assure that space, furniture and equipment are adequate to support current and future mission requirements. |
| Feature | Data | An abstraction of a real world phenomenon. A geographic entity with a location relative to the earth. Usually represented by vector data (points, lines and polygons) with geometry, topology and descriptive properties (attributes). |
| Foundation Data | Data | Base features or coverages that can be used as a common underlay for more specific mission or project data. |
| Framework Data | Data | The core types of geospatial data required in support of the agency mission. Meets National geospatial data standards. All Framework Data are registered to a common coordinate reference system. |
| Fusion | Process | The process of merging data by exploiting their geospatial-temporal properties. To combine geospatial data. To combine any agency enterprise data on the basis of their geospatial-temporal properties. |
| Gateway Service | Technology | The Gateway Service is a technology used to determine the geospatial position of a known mobile terminal from a wireless network. Position is expressed in geographic coordinates. Mobile terminals (cell phones, Personal Data Assistant (PDAs), etc) must be equipped with GPS or some other position determination technology. An important service used in Location-Based Services (LBS), in the wireless realm. |
| Gazetteer | Data | An authoritative source of geographic names with coordinate locations (see Geographic Names and Geonames). |
| Gazetteer Service | Function | The ability to determine the geospatial coordinates for a place, given place name and/or attributes. This function accesses a database of geographic place names, together with their geographic locations and other descriptive information. |
| Gazetteer Service | Technology | Able to access a Gazetteer (a directory of well-known places and their locations). It generally consists of point features. A Gazetteer Service is a network-accessible service that retrieves one or more features, given a query (filter) request. This filter request must support selection by well-known feature properties. Queryable feature properties include, but are not limited to, feature type, feature name, authority, or identification code. Each instance of a Gazetteer Service has an associated vocabulary of identifiers. Thus, a Gazetteer Service may apply to a given region, such as a country, or some other specialized grouping of features. The returned features will include one or more geometries expressed in a well-known Coordinate Reference System. |
| Geocode | Function | The ability to determine geospatial coordinates, given an address. |
| Geodetic Control | Data | Points of known precise location on the earth (latitude, longitude, elevation) as established through surveying or photogrammetric methods. Control points that are expressed in a common coordinate reference system (e.g., World Geodetic System 1984 (WGS – 84)). Geodetic control is required to accurately register spatial data. The National Spatial Reference System is the fundamental geodetic control for the United States. |

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| Geographic Affiliation | Data (Property) | Relates a person, good or asset to a physical location related to the earth (relative or absolute). These geospatial-temporal properties are stored in agency Framework Data under Party (Person or Organization), Goods or Asset Records. |
| Geographic Information System (GIS) | Technology | An integrated system of computer hardware, software, and set of procedures designed to create, store, query, display and analyze geospatial data and related attributes. |
| Geographic Names | Data (Property) | An authoritative source of geographic names with locations. E.g., Trafalgar Square, White House, Washington, D.C. Typically available through an online Gazetteer or Location-based Directory. (See Gazetteer and Geonames). |
| GIS Client | Technology | A general-purpose client, either thick or thin, that provides visualization and interaction with geospatial data. |
| GIS Server | Technology | The GIS server is comprised of bundled services that support the generation, revision, management, processing, and output of geospatial data. Consists of the server-side components comprising a GIS. |
| Geocoder/Reverse Geocoder Services | Technology | Able to determine geospatial coordinates, given an address (Geocoder), or determine address, given geospatial coordinates (Reverse Geocoder). A Geocoder 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 Geocoder 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 Geocoder Service, such as a street addressing or postal coding scheme. |
| Geolink | Data (Property) | A geo-enabled hyperlink (URI). This link may reference any geospatial-temporal resource (data/service). e.g., A geolink may reference a Location Object or a particular Feature on a given map. Geolinks provide the means to link between digital text/voice terms and the geospatial realm. |
| Geolocate | Function | The means to determine a geospatial position (the coordinates in a geographic coordinate reference system, a.k.a. position determination), or more generally, a location, for an object of interest (e.g., person, asset, conveyance, goods, cargo, device, etc.) |
| Geolocate Service | Technology | The means to determine a location for a fixed or Mobile Object of interest (e.g., geospatial feature, person, asset, conveyance, goods, cargo, device, etc.) Mobile Objects must be equipped with GPS, Radio Frequency Identification Device (RFID), and/or other position determination technologies. |
| Geometry (Geospatial) | Data (Property) | The geometric properties of geospatial data. |
| Geoname | Data (Property) | The designation/identifier (name) associated with a specific geographic location/place. A place name. E.g., Trafalgar Square, White House, Washington, D.C. Typically available through an online Gazetteer or Location-based Directory. |
| Geoparse | Function | The means to decompose text data in order to pinpoint geospatial and temporal terms. Optionally, also the means to geocode the terms and establish geospatial hyperlinks to geospatial-temporal resources (e.g., Location on a particular Map). |
| Geoparser Service | Technology | Geoparsing refers to the capability to scan and decompose a textual document, identifying key words and phrases that have geospatial-temporal context. A Geoparser Service works in the context of two bodies of information: a reserved vocabulary (a dictionary of place names, a gazetteer or a directory of Points of Interest (POIs) and a text source (e.g., a newspaper or cable.) The Geoparser returns all occurrences of the use (in the text source) of any term in the reserved vocabulary. Each occasion establishes a geolinks |

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| | | (geospatial/temporal-aware hyperlink) between text terms and the geospatial location associated with the reserved word. That result is an annotated text document with geolinks. |
| Geoprocessing | Process | The process of creating, updating, analyzing, modeling, rendering and otherwise utilizing geospatial data. |
| Georeferenced | Data | Any geospatial data. Earth associated data employing a geographic coordinate reference system. |
| Geosecurity | Data | The means to control and manage access on the basis of geospatial properties. |
| Geospatial Analysis | Data | The information products (data) that results from geospatial analysis. An Assessment. |
| Geospatial Analysis | Process | The process of mining, integrating, correlating, extrapolating, or otherwise analyzing geospatial data to determine geospatial-temporal patterns (e.g., cluster), densities, trends, networks, line of sight, tendencies, indicators, hypotheses and conclusions. See Threat Analysis, Threat Consequence Analysis, Vulnerability Analysis, Case Analysis, Damage Assessment, Event Analysis, Mitigation Planning & Analysis, Performance Planning & Analysis, and Screening and Risk Analysis. |
| Geospatial Application Components | Technology | Specialized Geospatial Applications may have one or more server-side Geospatial Application Components. These server-side components contain geospatial business logic and reference Geospatial Enterprise Services, which are common geospatial services that are available throughout the enterprise. |
| Geospatial Context | Data | Broadly, the geospatial characterization (classes, types and properties) of agency data. |
| Geospatial Coordinate | Data (Property) | The coordinates of a geospatial position expressed in a geospatial coordinate reference system, e.g., geographic – latitude, longitude, and elevation. |
| Geospatial Data | Data | Broadly, agency data that have geospatial properties or are defined as geospatial entity subtypes. agency geospatial entity subtypes include: Location Object, Feature, Coverage, Observation, Route, Mobile Object and Structure. Agencies require standards for common exchange of all geospatial entity subtypes embedded in any network messages, e.g., an Observation encoded in Geography Markup Language (GML). |
| Geospatial Data Format Conversion, Import/Export Services | Technology | Able to import/export, manipulate and convert geospatial data, through standard services. Formats include GML, MapInfo, ESRI, Intergraph, etc. |
| Geospatial Data Rollup (GDR) | Process | The means by which geospatial data are "rolled up" from data producer/steward nodes to common higher-level enterprise nodes, and then replicated as necessary. GDR is made possible by standards that are strictly and rigorously enforced between all nodes involved in rollup operations. Strict rules and guidelines for data creation and update transactions and reporting must also be followed. The objective of GDR is to optimize automation of the process so that all operational elements involved in the agency mission always have the best data. |
| Geospatial Data Standards | Data | The accepted models of authority associated with geospatial information (data). A type of standard under the Mandate subcategory of the Governance category. |
| Geospatial Data Transfer | Application | The means to move, copy, or exchange geospatial data between enterprise database nodes, which cuts across the agency enterprise. Includes operations to support periodic synchronizations of databases based upon update transactions to the master database. Used to |

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| | | accomplish replication operations between redundant nodes to support continuous 24/7 assured mission operations. Used to accomplish data rollup operations for Framework Data (synchronize data up the local-state-federal chain). Includes the required management tools. Produces Transaction Reports and Audit Trails. |
| Geospatial Data Transfer Standard | Data | Geospatial data format specifications to facilitate the exchange of geospatial data between organizations in a common data format. A type of standard under the Mandate subcategory of the Governance category. |
| Geospatial Entity Type | Data | The basic data type for agency geospatial data that are used in geospatial services. Includes the subtypes: Location Object, Feature, Coverage, Observation, Route, Mobile Object and Structure. |
| Geospatial Extent | Data | The area of a geospatial entity type, as defined by a minimum bounding rectangle or polygon. |
| Geospatial Information Technology (GIT) | Technology | Broadly applies to all geospatial information processing technologies. e.g., Position determination (GPS, etc.), GIS, Remote sensing (sensors and observations), Surveying, LBS, Location-Based Tag & Track, Telematics, AVL, Modeling & Simulation, Image Processing, Terrain Visualization, AM/FM and SCADA. |
| Geospatial Infrastructure | Technology | The underlying base or foundation geospatial technologies required for the agency enterprise. |
| Geospatial Integration Broker | Technology | A key component used in moving geospatial data between systems. |
| Geospatial Integration & Test Tools | Application | Tools that support examining and uniting of geospatial component services and applications. Consists of geospatial standards registry, reference implementations and test tools (including simulations and modeling for threat scenarios). |
| Geospatial Metadata | Data | Data about geospatial data. Any metadata that has geospatial properties. |
| Geospatial Model | Data | Data that define a geospatial schema. |
| Geospatial One-Stop Portal | Technology | An e-government initiative designed to facilitate the sharing and dissemination of geospatial data and resources over the Internet. A Web-based Portal for one-stop access to maps, data and other geospatial services. |
| Geospatial Processing Workstation | Technology | A Geospatial Processing Workstation is a high-end computer dedicated to GIS, Image Processing and other demanding geospatial processing tasks. Geospatial Processing workstations may be Unix or Windows based. They typically are characterized by large memory, large screen video, and massive disk storage. |
| Geospatial Product | Data | Broadly, any agency 'product' (i.e. artifact, data, map, widget, etc.) that have geospatial properties or are defined as geospatial entities. Any geospatial information that are published in accordance with standards for consumption by agency users, government officials and the public. Includes maps, imagery, location-based reports, assessments, analyses, plans, aids, profiles and so forth that characterize the earth and also the geospatial-temporal context of risks, threats, vulnerabilities, facilities, intelligence, events, hazards, plans, etc. |
| Geospatial Property | Data (Property) | The spatial geometry or attributes (including references) that define position on the earth (or location). |
| Geospatial Information Dissemination Protocols | Data | The standard procedures for passing geospatial content on a network (geospatial data and intelligence reporting and dissemination). |
| Geospatial Service | Data | The conventions associated with geospatial service components. |

| (Component) Standards | | |
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| Geospatial Standards | Data | Generally, the accepted and widely recognized models of authority or excellence that apply to agency geospatial capabilities. Consists of standards for geospatial services, data and communication protocols. |
| Global Positioning System (GPS) | Technology | A radio navigation system consisting of 24 earth-orbiting satellites that enable users to determine accurate geospatial position, velocity and time using a GPS receiver and associated computational capabilities. Determines geographic coordinates expressed in World Geodetic System 1984 (WGS - 84. Key technology for positioning, navigation and timing (PNT) in support of the agency mission. Useful for tracking and monitoring of assets, goods, cargos, persons and conveyances, especially for real-time operations. |
| Goods (Record) | Data | Assets being transported by Conveyance. The records for description (including a digital record of credentials), tracking and monitoring of assets (e.g., place of manufacture, shipping history in geospatial context – location/time/identity/status), and including money. May reference location, case, conveyance, risk, event (incident, occurrence, Event) or Party (person or organization) records. Subcategories include Cargo, parcels/packages, evidence, money, Hazmat and any other types of goods/things of interest. |
| Graphics Viewer Plug-in | Technology | The means to visualize and interact with 2D and 3D geospatial data in pictorial representation, where the user may interact/change geospatial elements. Provides tools to select geospatial features/locations/structures/routes/observations/mobile-objects for viewing, set view window, display chosen view, measure and pinpoint, navigate through view with pan and zoom, etc. Optionally choose symbology, graphics display template or select previous views. |
| Hazard | Data | A risk/danger (i.e., hazard) assessment in geospatial-temporal context, e.g., the floodplain for 100 year flood. May be Geospatial Data or Geospatial Product. |
| Hazard Map | Data | A graphic representation that conveys a risk/danger (i.e., hazard) assessment in geospatial-temporal context. A type of assessment, under the subcategory Assessment, under the Geospatial Product category. |
| Hazard Modeling, Analysis & Mapping | Application | The means to create, represent, break down, simulate and maintain detailed geospatial records of hazards for the purpose of characterizing and managing the threats (risks) associated with the hazard. Used in emergency preparedness, response and recovery planning and operations. Used to produce Hazard Maps and related Reports. |
| Hazmat (Records) | Data | The records for description (including a digital record of credentials), tracking and monitoring of hazardous materials, e.g., place of manufacture, or current, historical and scheduled location/time/identity/activity/status (shipping history). May reference location, case, conveyance, risk, event (incident, occurrence, Event), Party (person or organization), or case records. |
| Health & Safety Monitoring | Application | The means to track the locations of Notice of Violations (NOV) and reported incidents to assess problem work sites or otherwise dangerous conditions. Perform pre-deployment environmental health and safety evaluations of potential work sites, such as Disaster Field Offices (DFOs) or other temporary work environments. |
| Hydraulic-Hydrographic Modeling | Application | The means to create, control, display and store the results of hydraulic and hydrographic models, e.g., Hydrologic Engineering Center 2 (HEC2), Better Assessment Science Integrating Point and Non-point Sources (BASINS), and others. |
| Hyper-spectral Scanners | Technology | Any device that is specialized for measuring radian energy using contiguous bands of spectral data across a broad range of electromagnetic spectra. The resulting image can be visualized as a 3-dimensional dataset with two spatial and one spectral dimension, which is often referred to as an image cube. |

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| Identity (Records) | Data | The current descriptive geospatial information about a person, organization, or goods that defines their identity. For persons, can include place of birth, citizenship, current address(es), etc. Descriptive geospatial and identity information about goods, such as place of manufacture, address, etc. Includes digital records of credentials. |
| Image Processing Client | Technology | A desktop client, either thick or thin, that provides visualization and interaction with geospatial imagery data. Many specialized geospatial imagery applications may exist within the agency enterprise architecture. |
| Image Processing Server (IPS) | Technology | The IPS server is comprised of bundled services that support the generation, revision, management, processing, and output of geospatial image data. Consists of the server-side components comprising an IPS. |
| Image Viewer Plug-in | Technology | The means to visualize and interact with geospatial images (rectified or unrectified). Provides tools to select image and optional graphics overlays for viewing (geospatial features/locations/structures/routes/observations/mobile-objects), set view window, display chosen view, measure and pinpoint, navigate through view with pan and zoom, etc. Optionally choose symbology, image display template or select previous views. |
| Image(ry) | Data | A graphic representation of an object or scene, typically produced by an optical or digital electronic device. May be in still or motion format. Common examples include remotely sensed data (e.g., satellite data and airborne data), scanned data, aerial photographs, motion imagery, and photographs. An image is normally stored as a raster data set of binary or integer values that represent the intensity of reflected light, heat, or other range of values on the electromagnetic spectrum. |
| Imagery Analysis | Process | The process of examining (analyzing) and interpreting remotely sensed imagery in order to discern spatial patterns or features of interest. |
| Incident | Data | A specific instance of carrying out a threat that may or may not result in harm to a party or asset. It requires a response above and beyond the normal daily operations. Current and historical geospatial and temporal context associated with any type of incident, whether natural or man-made. Incidents may be occurrences of an instance of a single threat type, or include combinations of occurrences of multiple threats (e.g., high explosive combined with radiological-dirty bomb; hurricane or typhoon with flooding, etc). Incident data provide a complete historical geospatial and temporal context for all activities associated with the incident (preparation, mitigation, response, recovery), and may link to intelligence, maps, reports, analyses (risk, threat, vulnerability), plans (mitigation, preparation, response, recovery, etc.), consequence modeling outputs, assessments, and tracking of assets, parties, conveyances, goods, etc. associated with the incident. Includes location/time/identity/activity/status for all occurrences and activities associated with the incident. |
| Incident (/Event) Management | Application | The means to support command and control for an occurrence or event, including situation awareness, monitoring threats and threat assessments, coordinating and monitoring response activities, assets, personnel, etc., and reporting status to persons in the command and control chain (see incident reporting). Create and manage incident/event data. Generate and disseminate alerts and warnings. Support pertinent communications. Reference relevant weather and other supporting geospatial data. Determine containment areas, logistics and deployment plans and ingress/egress routes for incidents. Update incident/event records to reflect response results. |
| Incident Reporting | Application | The means to generate detailed accounts about occurrences for proper authorities. |
| Incident Report | Data | The geospatial-temporal context of occurrences in detailed account form(i.e., reports). Reports contain interlinked, multi-media data that adequately characterize the nature and context of the incident. Reports may contain references to plans, maps and other reports. |

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| Incident Report Service | Technology | Able to generate an Incident Report (detailed account of an occurrence) with information about a location-based incident message. |
| Integration | Process | The process of relating two or more physical data sets by exploiting geospatial-temporal properties, creating a virtual whole. To cross-reference related geospatial data. To integrate any agency enterprise data on the basis of their geospatial-temporal properties. |
| Intelligence | Data | Knowledge concerning threats and potential threats as it applies to the broad agency mission. |
| Interferometric SAR | Technology | Interferometric Synthetic Aperture Radar (InSAR) is a technique that enables measurement of very small movements of the earth's surface, as subtle as centimeters or less. The SAR interferometry technique acquires a pair of images from two radar measurements, taken from two marginally displaced coherent observations of the surface. For each pixel corresponding to the same ground area in both images, phase values are differenced to produce an interferogram, which, using the orbit parameters, is subsequently used to produce a Digital Elevation Model (DEM). |
| Interoperability (Geospatial) | Process | Ability of different processors, middleware, software and networks to interface and communicate with each other in order to share geospatial data and/or services. |
| Interview (Records) | Data | The geospatial context associated with conversations conducted to elicit specific information (i.e., interviews). |
| Intervisibility | Function | The means to determine whether or not there is clear visibility between two locations, or from an observation point/platform to an observation area. See line-of-sight. |
| Itinerary (Records) | Data | The detailed account(s) pertaining to a person's planned travel. The location/time/identity/planned-activities/status of places, persons and organizations to be visited. May include the means of transit, route(s), and travel guidance. |
| Key Asset | Data | Individual equities whose destruction would not endanger vital systems, but could create local disaster or profoundly damage our Nation's morale or confidence. Key assets include symbols or historical attractions, such as prominent national, state, or local monuments and icons. Key assets also include individual or localized facilities that deserve special protection because of their destructive potential or their value to the local community. Examples include: National Icons, Monuments, and Marine Resources. |
| Law Enforcement Assets | Data | A law enforcement officer's equipment: gun, munitions, baton, etc. These may be tracked by Asset Inventory Management and may or may not have geospatial context. |
| License/Permit (Records) | Data | The geospatial-temporal context associated with documented official or legal permissions. |
| Light Detection and Ranging (LiDAR) | Technology | The Light Detection and Ranging (LiDAR) is an active remote sensing system that can be operated in either a profiling or scanning mode using pulses of light to illuminate the terrain. By accurately measuring the round trip travel time of the laser pulse from the aircraft to the ground, a highly accurate spot elevation and topology can be calculated. |
| Line-of-Sight | Function | The means to determine whether or not there is intervisibility (visual line-of-sight) between two or more points in space, e.g., from a viewpoint to a target, between a point and an area or line, or between a line (e.g., flight path) and a point(s), line(s) or area(s). Also, the means to determine electronic line-of-sight for a signal. |
| Locate | Process | The ability to determine the position of a person, thing, or phenomenon. |
| Location | Data | A broadly used term that refers to any place of interest on the earth. |

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| Location Object | Data | Any place or site on the earth of interest in the agency mission. A position with geospatial coordinates. Generally, as used in agency business, a place or point of interest. Also, the location of a person, thing or any other phenomenon referenced to the earth. Includes Absolute Location and Relative Location. As defined by OGC (Location), the extensible, abstract data type for all expressions of location that can be used by geospatial applications and services to specify the location of a target, asset, conveyance, person, etc. As used in LBS, a Location is the root of a semantic tree that includes a Point, Position, Address, and Point of Interest as its subtypes. |
| Location-Based Messaging Client | Technology | The means to visualize location-based messages (communications with embedded geospatial elements). Example messages include alerts, warnings, emergency declarations, location report and situation reports. |
| Location-Based Messaging Service | Technology | The means to represent location-based messages (communications with embedded geospatial elements). Location-based messages include alerts, after action reports, warnings, emergency declarations, location reports, situation reports and other event Reports.<br><br>The Location Organizer Folder (LOF) is a standard message container model for capturing multi-media data in a geospatial context. It is based upon XML (Extensible Markup Language) and GML. |
| Location-Based Services (LBS) | Technology | Location-Based Services combine Web, wireless and geospatial technologies to provide the means to exploit positional information anywhere, anytime, and on any device. Generally, any services involving a mobile terminal (e.g., cell phone, PDA or notebook) and mobile users. |
| Location-Based Tag & Track | Technology | Technology for designating and following assets, equipment, goods, cargos, conveyances, and persons. e.g., GPS with RFID. |
| (Location) Directory Service | Technology | The (Location) Directory Service provides access to online lists (databases) of persons, places, products and/or services (e.g., Yellow/White/Green/Blue Pages, Restaurant/Travel/Entertainment Guides, Community Services, etc). This service is ordinarily used to find the location of a specific or nearest person, place, product and/or service. It is an important service used in LBS. |
| Location Reference | Data | Any means for representing location. A direct or indirect association to a physical location. Examples include an address, census block, geoname, coordinates, etc. Comprised of the standard geospatial elements/properties associated with any 'geospatial data' (i.e., any data which are captured, stored and managed within the agency enterprise as geospatial data), or with any 'non-geospatial data', which are any agency business data that are predominantly non-geospatial, and yet they have geospatial elements/properties that can be exploited through geospatial services. |
| Location Search & Reporting | Application | The means to search person, case, event, facility and property records using geospatial-temporal criteria, and then generate Location Reports conveying query results. |
| Location Report | Data | The query results pertaining to a person, case, event, facility or property expressed in location-based report form (detailed positional account). Reports contain interlinked, multi-media geospatial data. |
| Location (Site) Report Service | Technology | Able to generate a Location Report (detailed positional account) with information about an agency data object's location, related entities, and geospatial context. Example objects include geospatial feature, person, asset, conveyance, goods, cargo, device, etc. |
| Logistics Plan | Data | The documented management of the details of an operation. The geospatial-temporal context of an logistics plan, which includes maps and reports that convey objectives, schedules, deployments and contingencies concerning the distribution and use of goods (materials and supplies), assets, conveyances and related personnel in meeting the needs of emergencies. |
| Logistics Planning | Application | The means to produce logistics plans that convey the movement and deployments of goods, cargo, conveyances, assets and related |

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| | | personnel, for agency operations. |
| Manifest | Data | A list of passengers and cargo carried on a truck, ship, or other passenger or cargo conveying vehicle. |
| Map (and Charts) | Data | Generally, an annotated, symbolized graphical representation of select geospatial-temporal data for an intended purpose. Also, a map created by an orthorectified image. May contain annotations and marginalia. May be in hardcopy or softcopy form. May reference a Report or Plan. May be referenced by or embedded in a Report or Plan. |
| Map Publication | Application | The means to produce finished softcopy and hardcopy maps for use in agency operations. Includes the assembly and integration of data, symbolization, annotation, legend/marginalia generation and placement, and cartographic finishing. This capability is required throughout the agency enterprise. |
| Map Publication Service | Technology | Able to automatically generate and broadcast Maps of interest for inclusion in a plan, report, or other Geospatial Product, with select content and symbolization (map template). To produce a Map for inclusion in a word or graphic document. |
| Map Viewer Plug-in | Technology | The means to visualize and interact with geospatial data in rendered map form. Provides tools to select base map/image data for viewing, select optional graphics overlays (geospatial features, locations, structures, routes, observations, mobile-objects), set view window, display chosen view, measure and pinpoint, navigate through view with pan and zoom, etc. Optionally choose symbology, map display template or select previous views. |
| Metafeature | Data | An entity (feature) that synoptically represents and/or references other features. A complex or compound feature. |
| Mission Feature | Data | A geospatial entity that represents a pursuant target (object) or constraint in some agency operational context. Types of Mission Features include: At Risk Location (typically an area), Containment Area, Boundary Zone, Observation Area/Point, etc. Also see AOI, POI, and Place of Interest. |
| Mission-Specific Operating Picture (MSOP) | Data/ Technology | The collective set of time-sensitive, mission-critical, shared resources (data and services) associated with an area and subject of interest that conveys situational context for a mission. Contains geospatial context (a composite of Framework Data and Auxiliary Data), the disposition and nature of threat(s), friendly personnel and assets, as well as incidents, events, observations, related intelligence, and other relevant mission data. A MSOP draws upon the shared resources of the COP. |
| Mission Plan | Data | The scheme designed to reach specific objectives or assignments. The geospatial-temporal context of a mission plan, which includes maps and reports that convey objectives, threats, deployment/route details, contingencies and situation context for the mission, as well as the navigation instructions and guidance data to support electronic navigation. |
| Mission Planning | Application | The means to scheme, program, schedule and allocate assets to a mission; to develop data collection plans that convey schedule, tasking and resource allocation for collection assets. |
| Mission Rehearsal | Application | The means to verify and simulate pre-planned missions involving navigation guidance for mobile assets. Employs Mission Rehearsal Models. Input to these models consists of terrain, threats, threat avoidance constraints, features, weather, other environmental conditions, planned/predicted navigation guidance, asset operating constraints, etc. Outputs consist of 4D, simulated rehearsals, in their projected operating environments. |
| Mission Rehearsal Models | Data | Schematics that characterize the behaviors of mobile/dynamic mission (plan of action) assets and the effects of these assets in a mission rehearsal context. These models are associated with simulations of mission assets in their projected operating environments. |

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| Mitigation Plan | Data | The scheme designed to minimize and alleviate risks, hazards, emergencies or general occurrences. The geospatial-temporal context of a mitigation plan, which includes maps and reports that convey the planning, scheduling and allocation of all resources required to contain and minimize the impact of a disaster. |
| Mitigation Planning & Analysis | Application | The means to determine and assess impact of the root cause of an incident/event and to produce mitigation plans and supporting Geospatial Products (assessments, maps, reports, etc) for natural and human induced threats, hazards and disasters, in order to support future emergency response and recovery efforts for impending or possible disasters. Also, the means to analyze post-disaster response effectiveness (post mission assessments and after action reports) and create mitigation plans and supporting Geospatial Products to enhance future planning, safety, preparations, response and recovery operations, countermeasures and training for cases, threats, hazards and disasters. |
| Mobile Object | Data | Any entity (object) of interest that is in motion, or is otherwise dynamic, and is monitored and/or tracked. A person, good, conveyance or asset. Mobile objects have location, time, identity, activity, status, and optionally speed and direction of motion. Historical records of location/time/identity/activity/status/speed/direction may be recorded for tracking purposes. |
| Model | Data | The schematic description of data that accounts for its properties and characteristics. Geospatial-oriented model to support simulation and autonomous operations. Models have a data perspective (model input and output parameters) and a behavior perspective (software). |
| Modeling & Simulation | Process | The means to predict aspects of the behavior of some system by creating an approximate (mathematical) model of it. Modeling in space and time through a special-purpose software package, or a more general simulation package aimed at a representation of the attributes of a system. |
| Monitor | Process | The ability to systematically observe and report on a location (place/area/point of interest), feature (e.g., building), person, goods, assets, conveyances etc. with the purpose of collecting information about location/time/identity/activity/status. |
| Monitor Assets | Application | A program that observes, supervises, manages, or controls the equities or items of value. The means to monitor Assets for change in location/activity/status. To determine and record the current and historical location/time/identity/activity/status of mobile assets, including capital assets, key assets, law enforcement assets, and operational materials and equipment, through observation, tracking and analysis. To perform situation awareness. May lead to reporting of occurrences (e.g., Suspicious Activity Reporting), alerts or Situation Reports. |
| Monitor Conveyances | Application | A program that observes, supervises, manages, or controls transports. The means to monitor Conveyances for change in location/activity/status. To determine and record the current and historical location/time/identity/activity/status of conveyances through observation, tracking and analysis. To perform situation awareness. May lead to reporting of occurrences (e.g., Suspicious Activity Reporting), alerts or Situation Reports. |
| Monitor Goods & Cargo | Application | A program that observes, supervises, manages, or controls freight, merchandise, payload, or equities. The means to monitor Goods and Cargo for change in location/activity/status. To determine and record the current and historical location/time/identity/status of goods and cargo through observation, tracking and analysis. To perform situation awareness. May lead to reporting of occurrences (e.g., Suspicious Activity Reporting), alerts or Situation Reports. |
| Monitor Locations | Application | A program that observes, supervises, manages, or controls places, sites, positions, streets, neighborhoods, venues, localities, etc. The means to monitor Locations for change in activity/status. To determine and record the current and historical time/activity/status at a |

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| | | location through observation and analysis. To perform situation awareness. May lead to reporting of occurrences (e.g., Suspicious Activity Reporting), alerts or Situation Reports. |
| Monitor Parties | Application | A program that observes, supervises, manages, or controls people, persons, citizens, crowds, etc. The means to monitor Parties (Persons or Organization) for change in location/activity/status. To determine and record the current and historical location/time/identity/activity/status of persons in geospatial context and cyberspace, through observation, tracking and analysis. To perform situation awareness. May lead to reporting of occurrences (e.g., Suspicious Activity Reporting), alerts or Situation Reports. |
| Monitor Recovery | Application | A program that observes, supervises, manages, or controls cleanup, decontamination and restoration. The means to monitor incident locations for change in activity/status pertaining to cleanup, decontamination and restoration. Employ recovery plans to support recovery operations. Determine and record the current and historical time/activity/status at recovery locations through observation and analysis for subsequent analysis and legal implications. Produce location-based After Action Reports that contain recovery progress, and environmental impact assessments. |
| Monitoring Service | Technology | Able to determine (or fetch a predetermined) location/time/identity/status/activity series for a Location. |
| Multi-spectral Scanners | Technology | Any device that is specialized for measuring radian energy of the earth's surface using discrete bands of spectral data ranging from the blue to the near-infrared portions of the electromagnetic spectrum. |
| Mutual Aid Support Plan | Data | May result from certain planning and analysis activities for major events, emergency preparations/response/recovery, etc. The geospatial-temporal context of the mutual aid support plan, which includes maps and reports that convey plan objectives (deployment sites, logistics, etc), schedules and activities in geospatial context. |
| National Affiliation | Data (Property) | Relates a person, good or asset to a nation. |
| (The) National Map (TNM) | Data | A seamless, continuously maintained set of Base data for the U.S., consisting of both feature and coverage data that meet consistent National standards. The National Map (TNM) will serve as the central portal for the sharing and dissemination of critical geospatial information. The 'Base Map' for agency operations. |
| National Spatial Data Infrastructure | Data, Technology | Provides a consistent means to share geographic data among all users. This includes all technologies, policies, and people necessary to promote sharing of geospatial data throughout all levels of government, the private and non-profit sectors, and the academic community. |
| Native Spatial DBMS | Technology | The Enterprise Database Management System (DBMS) should provide native support for storing and managing all types of geospatial data. Capabilities should include geospatial indexing, open Structured Query Language (SQL) query support with geometry and topology operators, geospatial analytics, geospatial data mining, coordinate transformation and linear referencing. |
| Nautical Navigation | Data | Data which pertains to nautical navigation, such as waterways, ports, harbors, bridges, navigation aids, traffic, traffic control, (electronic) navigation guidance, fixed hazards and dynamic hazards. |
| Navigation | Process | The guidance of conveyances or persons from place to place. The act of navigating; the act of passing on water in ships or other vessels or in the air in aircraft; the state of being navigable. |
| Navigation Guidance | Data | The navigation instructions and directional data for use in computer-assisted navigation (e.g., Notice to Mariners). |

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| Navigation Service | Technology | An enhanced version of the Route Service, which determines routes between two or more points with enhanced navigation information. An important service used in Location-Based Services (LBS). |
| Network | Data | A complex interconnected group or system. Includes the following type (of networks): terrorist, hostile interest affiliation, road transportation (road, air, rail, and sea), logistical, energy distribution, communications, water supply, food distribution, emergency response, financial, sociological, etc. |
| Network Analysis | Function | The examination of a complex interconnected group or system. The means to analyze transportation, telecommunications, energy supply, water supply and any other networks in geospatial context. The means to determine a Route. |
| Notice | Data | Alert information or messaging (notification) between operational actors containing geospatial and temporal context. |
| Observation | Data | Data derived from sensor measurement, human detection, and other sensing and measurement techniques. |
| Observation Point | Data | A location from which observations (detecting, viewing, sensing) are made by human and/or sensors for monitoring or tracking purposes. A type of Mission Feature. |
| Observation Area | Data | An area under observation (detection, surveillance, supervision) by human and/or sensors for monitoring or tracking purposes. A type of Mission Feature. |
| Occurrence | Data | An activity (routine transaction) that is of interest in the agency mission. Can be something that happens at a specific point in time or over a period of time. It requires an expected response as part of normal operations. The geospatial-temporal context of current and historical locations of any suspicious, criminal, terrorist activities of interest, including arrests, offenses, confiscations and seizures. May reference multi-media geo-referenced data (e.g., maps, reports, motion video, still images, etc.) Defines the identity/location/time/activity/status for any activity of interest. |
| Operational Plan | Data | A documented process for a particular method of efficient, productive activity. The geospatial-temporal context of an operations plan, which specifies the allocation of funds, activities and resources by organization and geographic area (congressional district, state, territory, county, reservations, and cities). May also include maps and reports that convey objectives, schedules, deployments, contingencies and the situation context for projected operations, including: threat disposition, blue force disposition, contingency deployments, environmental constraints, etc. Plans may also include standard operating procedures for geospatial data acquisition, management and sharing, as well as the geospatial management and investment plans for all levels of government, developed in cooperation with private and public sector entities. |
| Operational Planning | Application | A program designed to document the process for a particular method of efficient, productive activity. The means to scheme, schedule and allocate personnel and assets for emergency operations. To develop Operational Plans. |
| Organization (Records) | Data | An administrative or functional entity established formally or informally to represent interests or issues or to conduct an activity, as opposed to an individual or person representing oneself. The records for describing and monitoring organizations of interest. Description includes relevant geospatial locations. Monitoring produces current and historical location/time/identity/activity/status data. May reference events (occurrences, incidents), alerts, cases, assets, conveyances, persons, and affiliations with hostile interests. |
| Party | Data | A unique individual (living or dead). Can be characterized or identified by historical, biographic, and biometric information. A person or organization of interest in the agency mission for which geospatial-temporal context is required. |

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| Patrol | Process | Moving about an area or along a border for the purpose of observation and inspection. Includes engaging adversaries, suspected threats, and perpetrators. |
| Performance Criteria | Data | The rules or standards for assessing system accomplishment (performance) based upon geospatial considerations. |
| Performance Model | Data | Schemas (models) that characterize the key performance indicators of agency systems. These models are associated with system performance simulations that are used in performance analyses. Input to these models consists of performance criteria and geospatial performance factors (incidents, events, districts, etc), i.e., geospatial entities of interest for performance monitoring purposes. Model output consists of performance measures by geographic entity/locations. |
| Performance Plan | Data | The planned/projected/predicted performance of a system or system resources based upon geospatial factors and criteria. |
| Performance Planning & Analysis | Application | The means to determine system performance based upon geospatial-temporal factors and criteria. Track and report on Events, incidents, key assets, vulnerabilities, grants, expenses and funding by geospatial areas (congressional district, state, territory, county, reservations, and cities) for agency activities. Create and evaluate performance criteria and annual performance plans (including accountability reports). |
| Person (Record) | Data | The records for description, tracking and monitoring of persons. Includes identity (digital records of credentials, place of birth, citizenship, address) and other biographical information including travel history, geographical/national affiliations, etc. Tracking and monitoring of persons produces current, historical and future (planned or projected) location/time/identity/activity/status data. Person records may include subcategories of other business data including records containing background check, interview, custody, travel, history, itinerary, and license/permit information. May reference events (occurrences, incidents, events), cases, conveyances and organizations, employment, activity, asset, and risk. |
| Personal Map Software | Technology | Personal Map Software includes a variety of tools for viewing, annotating and manipulating map data. Typically include map data for standalone operations. Often includes GPS capability for mobile applications. Commercial software for desktop or PDA. |
| Photogrammetric Cameras | Technology | Cameras that are specialized for the remote capture and measurement of panchromatic (350-1100 nm) data of the earth's surface. These units are typically mounted on airborne craft and produce photographs that can be transformed into a geo-registered image product using specialized photogrammetric software applications. |
| Place of Birth | Data | Location associated with a person's birth. |
| Place of Destination | Data | Shipping or travel destination. |
| Place of Interest | Data | May be represented as a point (i.e., point of interest) or an area (i.e., area of interest). |
| Place of Manufacture | Data | Place where a good is manufactured. |
| Place of Origin | Data | Shipping or travel origin. |
| Plan | Data | A documented course of action to be taken in order to achieve a specified goal or objective that is officially designated as a Plan. The results of planning pertaining to a topic of interest, such as an exercise, mission, recovery, etc. The geospatial-temporal context of a Plan. Plans include supporting facts, objectives and projections. May reference one or more Reports, Plans or Maps. |

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| Point of Interest (POI) | Data | A place or entity with a fixed position that may be used as a reference point or a target. Generally, any point of interest within the mission. A location of interest represented as a point in a known coordinate reference system, with metadata describing the location. May also contain name, type, category, address, phone number and other information about a place. |
| Position | Data | Any observed or calculated position, in the broad semantic context of the use of the term. Primarily contains a geographic position and quality of position. The geospatial coordinates, accuracy and precision of a point or vertices of a line or polygon. |
| Post Mission Analysis | Application | The means to assess the performance of a mission and assess effectiveness of mission, event, preparation, logistics, response, deployment, evacuation, search & rescue, security, countermeasures, (training) exercise and recovery plans, and the effectiveness of mission operations (assess incident and situation reports). The ability to compare plans with mission operations details and determine lessons learned. The means to produce post mission assessments that convey analysis results (maps and location-based reports), and to produce and after action reports. |
| Post Mission Assessments | Data | The analysis output from Post Mission Analysis. Assessments of the effectiveness of plans, operations and training in response to an incident/event/case. |
| Preparation Plan | Data | The geospatial-temporal context of an emergency preparedness plan, which includes maps and reports that convey preparation objectives, schedules, deployments, contingencies and geospatial-temporal situation context for planned operations. |
| Preparation Planning | Application | The means to preplan, schedule and allocate personnel and assets to a potential disaster/threat; to develop operations plans that convey schedule, tasking and resource allocation for preplanned operations, in a geospatial-temporal context. The means to produce deployment and contingency plans. |
| (Threat) Profile | Data | A geospatial-temporal pattern, trend, network, tendency or indicator that characterizes threat and risk behaviors. Used in determining location, identity, severity and probability of the risk/threat. [Note: Other types of location-based profile may be defined for the agency mission.] |
| Profiling | Function | To detect or calculate a geospatial-temporal pattern, trend, network, tendency or indicator by evaluating a set of geospatial entities and/or a set of agency business data with geospatial properties. Used for detecting new risks and threats. e.g., Detect a visitation pattern by analyzing immigration data for suspected terrorists and their associates. |
| Program Plan | Data | The geospatial-temporal context of a program plan, which includes maps and reports that convey program objectives, schedules and geospatial-temporal situation context for planned activities. |
| Program Planning | Application | The means to preplan, schedule, and allocate personnel and assets for an agency activity; to develop activity plans that convey schedule, tasking and resource allocation for preplanned activities, in a geospatial-temporal context. The means to produce Program Plans. |
| Public Information Outreach | Application | The means to inform the public on the basis of location. Portray maps (e.g., NFIP (National Flood Plain Insurance Program) floodplain maps) and location-based information reports, alerts, warnings and emergency declarations concerning threats, threat consequences, response and recovery status, mitigation and situation reports, and benefits locations through public information (media) channels. Allow the public to interact through these channels (e.g., explore what's happening in their area of interest). Support electronic registration (geocoding) for the application of benefits. Numerous types of geospatial products produced by geospatial applications across the enterprise may be distributed through public information channels. |

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| Raster | Data | An abstraction of the real world where spatial data is expressed as a matrix of cells or pixels, with spatial position implicit in the ordering of the pixels. Unlike vector data, there are no implicit topological relationships. Coverages are often represented in raster form. e.g., imagery. |
| Recovery Plan | Data | The geospatial-temporal context of an emergency recovery plan, which includes maps and reports that convey recovery objectives, schedules, resource deployments, contingencies and geospatial-temporal situation context for planned recovery operations. |
| Recovery Planning | Application | The means to preplan/plan, schedule, and allocate personnel and assets for incident recovery; to develop recovery (operations) plans that convey schedule, tasking and resource allocation for recovery operations, sharing amongst government and non-government relief organizations. Publish locations and route directions to crisis counseling, housing and other recovery centers; share with public. |
| Reference Architecture (Geospatial) | Technology | Consists of reference implementations of key geospatial components and applications with standard interfaces. Also consists of a registry of associated geospatial standards and conformance test tools. |
| Relative Location | Data | A location stated as a relative position with respect to an Absolute Location (i.e., address, position, feature geometry, e.g., point, or Place of Interest). |
| Report | Data | A location-enabled, multimedia report. The results of reporting pertaining to a topic of interest, such as an emergency, incident, suspicious activity, etc. The report has geospatial-temporal context, which includes supporting data such as locations, features, imagery, etc. May reference one or more Reports, Plans or Maps. |
| Response Plan | Data | The geospatial-temporal context of an emergency response plan, which includes maps and reports that convey response objectives, schedules, resource deployments, contingencies and the geospatial-temporal situation context for planned response operations. |
| Response Planning | Application | The means to preplan/plan, schedule and allocate personnel and assets to a disaster/threat/incidents/events, given possible risks, public safety considerations and potential affected locations, facilities, key or critical assets, etc.; to develop response operations plans that convey schedule, tasking and resource allocation for response operations, in a geospatial-temporal context. The means to produce Response Plans. |
| Reverse Geocode | Function | The ability to determine an Address from geospatial coordinates. |
| Risk | Data | The nature of the risk associated with a threat, vulnerability or weapon. Risks correlate threats with vulnerabilities. The geospatial context of a risk is defined in a Risk Assessment. |
| Risk Analysis | Application | The means to determine and assign risks and risk assessments for key assets, critical assets, key persons or conveyances. To analyze associated geospatial risk factors, in conjunction with related threat, vulnerability, threat intelligence and other intelligence. Consists of mapping and correlating threats to vulnerabilities. Means of analysis may consist of: (data) mine, integrate, correlate, extrapolate, and analyze data for patterns, densities, trends, networks, line of sight, tendencies, indicators, hypotheses, and conclusions, as it pertains or may pertain to risks. May also involve geoparsing and geocoding functions to scan and annotate textual risk, risk assessment, threat, threat assessment, vulnerability, vulnerability assessment, person, conveyance, threat intelligence and other all-source intelligence for geographic and temporal references. |
| Risk Assessment | Data | The modeling and analysis output from Risk Analysis. May consist of maps and/or reports. |

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| Route | Data | The representation of a route for navigation purposes. The route's overall characteristics, such as its start point, waypoints, end point, transportation type, total distance, travel time and bounding box. Route geometry is defined as a list of geographic positions along the route, ordered in the sequence of planned travel, starting with the position of the route's origin and ending with the position of the route's destination, including waypoints. Also, a list of travel instructions consisting of turn-by-turn directions and advisories along the route, ordered in sequence of their occurrence. Routes are derived from navigable transportation networks. |
| Route Service | Technology | Able to determine (or fetch a predetermined) route and navigation information for autonomous or semi-autonomous navigation between two or more points on a network. An important service used in LBS, in the wireless realm. |
| Screening & Risk Analysis | Application | The means to determine and assign risks and risk assessments for parties (persons or organizations) and goods, and to screen accordingly. Analyze geospatial risk factors (e.g., physical address, place of birth, citizenship, travel history, travel itineraries, geographic/national affiliations, etc. for persons and organizations, and place of origin, place of manufacture, shipping route and place of destination for goods) in conjunction with party and goods records and related intelligence. Data mining and correlation applies here. May also involve geoparsing and geocoding functions to scan and annotate associated textual data for geographic and temporal references. |
| Search & Rescue Plan | Data | The geospatial-temporal context of search and rescue plan, which includes maps and reports that convey search & recovery objectives, schedules, resource deployments, contingencies and geospatial-temporal situation context for planned search & rescue operations. |
| Search & Rescue Planning | Application | The means to preplan/plan, schedule and allocate personnel and assets for search and rescue missions. The means to develop Search & Rescue Plans that convey schedule, tasking and resource allocation for search & rescue operations, in a geospatial-temporal context. Create and manage related incident/event data. Generate alerts and warnings, as needed. Support pertinent communications. |
| Search & Rescue Response | Application | The means to support command and control for an incident or event that requires search and rescue. Involves creating and managing situation awareness, monitoring threats and threat assessments, coordinating and monitoring response activities/assets/personnel, communicating with response personnel, etc., and reporting status to persons in the command and control chain (Situation Reports). Create pertinent communications. Update incident/event records to reflect response results. |
| Security Planning | Application | The means to determine and document the security plans, in geospatial context, to secure and protect fixed and mobile assets, persons, goods, conveyances, etc. |
| Security Plan | Data | Documents the security measures for protecting persons, assets, goods, conveyances, etc., in map and report form (e.g., Where to place barriers, guard posts, sensors, etc.). Includes details concerning sensor deployments. |
| Security Protection & Management | Application | The means to secure and protect fixed and mobile assets, persons, goods, conveyances, etc. (in geospatial context). (e.g., Where to place barriers, guard posts, sensors, etc. Where are the guards, sensor alerts, etc.). Includes integration with sensors and other security monitoring tools and the means to process and display observations. May lead to reporting of events or alerts. |
| Semantic Business Profiles (SBP) | Data | Business semantic schemas that define the common semantic framework (terms and their meanings within the enterprise environment) associated with shared geospatial business processes and procedures. SBPs are exposed through registry services. Defined by COI. |
| Semantic Data Profiles (SDP) | Data | Data semantic schemas that define the common semantic framework (terms and their meanings) associated with shared geospatial data description and access. SDPs are exposed through registry services. Defined by Communities of Interest. |

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| Semantic Interoperability Services | Technology | Fully autonomous business, service and data interoperability is only possible when clients can locate and access business, service and data on-the-fly through publish-find-bind-orchestration patterns that subscribe to well-known business, service and data semantics. |
| Semantic Service Profiles (SSP) | Data | Service semantic schemas that define the common semantic framework (terms and their meanings) associated with shared geospatial service description and access. SSPs are exposed through registry services. Defined by Communities of Interest. |
| Sensor | Data | The description and parameters associated with a sensor for the purpose of sensor management and the exploitation of observations from the sensor. |
| Sensor | Technology | An electronic device that is used for detection and monitoring through signature and pattern recognition. |
| Sensor Alert Service | Technology | The Sensor Alert Service produce alert messages when given observation conditions are met by a sensor. Provides the means for client services/users to specify and register user profiles that contain user information, applicable sensors/observations, alert conditions (e.g., maximum/minimum values), and alert actions (what happens if conditions are met). Also, the means for client services/users to update user profiles. Clients are able to control the nature of alerts. For example, a client is able to activate/deactivate an alert capability. Also provides the means to support push/pull capabilities, e.g., to wait for observation input from associated sensors (for on/off sensors such as a detector), or to actively poll for (current/historical/predicted) sensor observations. |
| Sensor Management | Application | The means to manage sensor assets and the allocation of data collection requirements and tasks to sensors. |
| Sensor Collection Service | Technology | A service by which a client can obtain observations from one or more sensors/platforms (can be mixed types). Clients can also obtain information that describes the associated sensors and platforms. |
| Sensor Planning Service | Technology | 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. |
| Service Discovery Service | Technology | Able to search for and locate desired services through open, standard publish-find mechanisms. Search requests may be defined in terms of filters for discovering services and service-data relationships, and optionally storing the metadata results as a new data set. |
| Share | Process | The means for two or more actors in a system to access and utilize the same resources (data, services, devices, etc.). Commonly refers to sharing data between federal, state, local, tribal and private users through network-accessible, standards-based services. |
| Site Modeling & Analysis | Application | The means to analyze, model and delineate areas based upon site characteristics (e.g., to locate ideal sites for a facility). To produce Site Plans. |
| Site Plan | Data | The results of site planning. The geospatial-temporal context of the plan, which includes maps and reports that convey site objectives/schedules, activity locations and the situation context for the site (e.g., facility/infrastructure locations, other key features, current imagery, etc.). |
| Situation Awareness | Data | A coherent representation of data for an area of interest that conveys geospatial situational context, disposition and behaviors of threat(s), friendly personnel and assets, incidents, events, observations and related intelligence and agency Framework Data. Closely related to a COP, MSOP, or a specialized view of the COP/MSOP, a.k.a. USOP. |
| Situation Awareness | Application | The means to combine varied sources of data to create the situational context associated with threats, vulnerabilities and friendly forces for the purpose of understanding their nature and disposition and to support decision making for threat response and mitigation. In |

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| | | particular, view near-real time threat disposition, related observations, and friendly force disposition in geospatial context, with the appropriate level of detail. Leads to a shared, collaborative COP, MSOP, or specialized views of the COP/MSOP that convey actionable information, a.k.a. USOP. The means to generate Situation Reports. |
| Situation Reports | Data | Reports that contain relevant geospatial-temporal situation context for any activity/event/incident/occurrence for command and control purposes. |
| Situation Report Service | Technology | Able to generate a Situation Report with the geospatial extent and nature of an operational situation. |
| Spatial Reference System | Data (Property) | A function that associates locations in space to geometries of coordinate tuples in a mathematical space, usually a real valued coordinate vector space, and conversely associates coordinate values and geometries to locations in the real world, e.g., coordinate reference systems, linear reference systems. |
| Spatial Relationship | Data (Property) | The relationship between two objects as described in geospatial terms (distance, coordinates, etc). Also topological relationships, e.g., adjacent, connected, surrounded by, etc. |
| Specialized Geospatial Clients (Various) | Technology | A desktop client, either thick or thin, that provides visualization and interaction with geospatial data. Also provides access to underlying Application Components and Geospatial Services. Many specialized geospatial applications will exist within the agency enterprise architecture, each which may have a Geospatial Client and one or more Application Components and/or Geospatial Services. |
| Speed (velocity) | Data (Property) | The rate of motion or a measure of the rate of motion. Distance traveled over an interval of time. Often represented by a vector(s) indicating direction of motion. |
| Structure | Data | The geospatial representation of a man-made structure, e.g., building or bridge. |
| Style Management Service (SMS) | Technology | The means to create, update and manage styles and symbols. The SMS must manage distinct objects that represent styles and symbols and provide the means to discover, query, insert, update, and delete these objects. Styles provide the mapping from feature types and feature properties and constraints to parameterized Symbols used in drawing maps. Symbols are bundles of predefined graphical parameters and predefined fixed graphic "images". |
| Suspicious Activity | Data | Represents any suspicious activity or occurrence of interest (identity/activity/status) that poses a risk (threat or vulnerability) or potential risk, with geospatial context (location/time, extent, geographic, national), or a series of suspicious activities/occurrences with geospatial-temporal contexts. |
| Suspicious Activity Report | Data | The geospatial-temporal context of suspicious activities captured in report form. May reference maps, incidents, occurrences, parties, threat intelligence, risks/threats/vulnerabilities, etc. Reports contain interlinked, multi-media data that adequately characterize the nature and context of the activity. |
| Suspicious Activity Report Service | Technology | Able to generate a Suspicious Activity Report for a location-based suspicious activity. |
| Suspicious Activity Reporting | Application | The means to analyze and report suspicious/criminal/terrorist activities to proper authorities (e.g., indications of a threat, notifications of suspected criminal activities, etc). |

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| Surveillance | Process | Observing activities in an area of interest or at a point of interest through visual/listen inspection or sensors. |
| Synthetic Aperture Radar (SAR) | Technology | A microwave instrument that transmits radar pulses very rapidly. In fact, SAR is generally able to transmit several hundred pulses while the platform passes over a particular object. Many backscattered radar responses are therefore obtained for that object, which can be manipulated such that the resulting image looks like the data were obtained from a big, stationary antenna. In general, the synthetic aperture is the distance traveled by the spacecraft while the radar antenna collected information about the object. |
| Tariff Management | Application | The means to manage tariffs for goods, in a geospatial context. |
| Temporal Reference System | Data (Property) | A function that associates time to a coordinate (usually one dimensional points and intervals) and conversely associates coordinate geometries to real world time. |
| Temporal Relationship | Data (Property) | The relationship between two events with respect to time; or pertaining to a specified period of time. |
| Test Model | Data | The test models (data and encoded procedures) to support simulations and modeling to test how geospatial data and technology will perform in local conditions and in different attack scenarios. |
| Threat | Data | An intended or unintended indication of imminent danger, harm, evil, etc. Includes infestation of a commodity by living pest. The geospatial context of a Threat is defined in a Threat Assessment. |
| Threat Analysis | Application | The means to define threats and threat assessments. For terrorism, the means to (data) mine, integrate, and correlate varied types of geospatial data for the purpose of extrapolating, modeling, analyzing and deriving geospatial data in the form of patterns (e.g., cluster), densities, trends, networks, line of sight, tendencies, indicators, hypotheses, and conclusions, as it pertains to threats and the understanding of threat behaviors in their environment, in order to minimize the risks associated with the threat. Source data include, but are not limited to, intelligence, incidents, events, criminal and suspicious activities, financial transactions, persons, organizations, goods, etc. For terrorism and natural hazards, this includes the means to conduct Threat Consequence Assessments and Hazard Modeling, Analysis & Mapping. May also involve geoparsing and geocoding functions to scan and annotate associated textual data for geographic and temporal references. |
| Threat Assessment | Data | The modeling and analysis output from Threat Analysis. For natural hazards, this includes floodplains and areas of high susceptibility from tidal storm surge, hurricane, tornado, landslide, earthquake, fire, tsunami, volcanic events, high winds and other types of natural disasters. |
| Threat Consequence Assessment | Application | The means to understand the consequences of terrorist and natural threats as determined by modeling/simulation and analysis (e.g., Consequence Assessment Tool Set (CATS)). The means to produce Threat Consequence Assessments for threats to key assets, critical assets, key persons or conveyances (and associated routes). Means of analysis may consist of: (data) mine, integrate, correlate, extrapolate, and analyze data for patterns, densities, trends, networks, tendencies, indicators, hypotheses and conclusions, which pertains or may pertain to threats. May also involve geoparsing and geocoding functions to scan and annotate associated textual data for geographic and temporal references. |
| Threat Consequence Assessment | Data | The modeling and analysis output from Threat Consequence Assessment. |

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| Threat Detection | Application | The means to detect chemical and biological threats in air and water through the employment of sensors. The means to access sensors as network resources to meet rapid response and risk mitigation requirements. Detect threats through screening and analysis of sensor observations. Create, reference and share alerts. |
| Threat Intelligence | Data | Intelligence data that pertains to a threat and the associated risks that the threat poses. |
| Threat/Vulnerability Mitigation Strategy | Data | Generally, the geospatial-temporal context of a threat/vulnerability mitigation strategy. Specifically: Security Plans, Countermeasures or Mission Plans. |
| Threat Prediction | Data | The predicted location/time/identity/activity/status information for a threat. |
| Threat Models | Data | Models that characterize threats and threat behaviors in a specified environment, under specified conditions/constraints. Behaviors are represented by operational constraints/patterns/preferences/ tendencies/etc. (e.g., for attack, deployment, etc.), threat consequences, etc. |
| Threat Warnings & Alerts | Data | A Warning or Alert pertaining to a threat. Determined by observation, modeling or analysis, and correlation with one or more incident(s), occurrence(s) or observation(s). |
| Topology Services | Technology | Able to detect topology errors (e.g., overshoots and undershoots of common linear and polygonal features within a definable tolerance), automatically correct errors, if possible, and define topological relationships between connected/collocated linear, polygon, and point features. |
| Track | Data | A sequence of observations and/or predictions concerning the location/time/identity/activity/status for persons, goods, assets, conveyances or any other mobile objects for a given period of time (current, historical and planned/projected). Optionally, to also represent speed and direction of motion. |
| Tracking | Function | The means to observe or otherwise determine the location/time/identity/activity/status for persons, goods, assets, conveyances or any other mobile objects for a given period of time (current, historical and planned/projected). |
| Tracking Service | Technology | Able to determine (or fetch a predetermined) location/time/velocity/identity/status/activity series (track) for a Mobile Object (e.g., persons, goods, assets, devices, etc.) |
| Traffic Service | Technology | The means to access traffic information regarding incidents and/or conditions for a specified area of interest, road, or road segment, for a specified time period.<br><br>Also, the means to access traffic information regarding incidents and/or conditions for a designated route (that has been determined by a Route Service or Navigation Service) for a specified time period. |
| Training Aids | Data | The means to produce geospatial training aids in support training exercises, and in the form of maps, reports and plans. |
| Training Exercise Simulation | Application | Provide training simulations capabilities to support training exercises. The simulations employ geospatial data and technology to simulate different attack scenarios. Uses training models and supporting databases. |
| Training Models | Data | The training models (data and encoded procedures) to support training simulations in order to test how geospatial data and technology is going to perform in local conditions and in different attack scenarios. |

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| Training Planning & Support | Application | The means to plan training exercises and produce geospatial training aids in the form of maps, reports and plans. |
| Training Plan | Data | The results of training planning and support. The geospatial-temporal context of the resulting training plan, which includes maps and reports that convey objectives/schedules, activity locations and situation context for the (training) exercise, including: potential threat locations, threat consequences, asset locations, population densities, evacuation routes, mutual aid support facilities, etc. |
| Transaction Report | Data | Reports that summarize geospatial transactions for specified time periods. |
| Transshipment Point | Data | An intermediate location (waypoint) in a shipping route for goods and cargo where the means of conveyance changes. A subtype of Route. |
| Travel History (Records) | Data | The record(s) pertaining to a person's or conveyance's past travel. The location/time/identity/activity/status of places, persons, organizations that are visited. Includes the means of transit. |
| Travel Planning | Application | The means to plan secure and safe travel for individuals. Produces itineraries. |
| User-Specific Operating Picture | Data | The User Specific Operating Picture (USOP) is an actionable data view of an MSOP that is specialized for a user, in a specific role, on a specific device. USOPs are application-dependent data views that are created through the COP and MSOP collaborative workspaces, and are dependent upon the specific user/application context. USOPs will vary from activity to activity and from individual/device to individual/device. [Thus, each agency activity/application will have to be evaluated to consider collaboration needs and the scope of each USOP.] |
| Vector | Data | An abstraction of the real world where positional data is represented in the form of coordinates. The basic units of spatial information are points, lines and polygons, where each is composed as a series of one or more coordinate points. Features are generally represented by vector geometry. |
| Verification Event (Records) | Data | The records of identity verification events associated with a Person or Good. |
| Visualization | Process | The rendering of geospatial data into a product or medium which allows an analyst or user to review, visually assess and draw conclusions about the underlying information. |
| Vulnerability | Data | Potential targets where the United States and its interests are open to attack by armed forces, terrorists, etc. The geospatial context of a vulnerability is defined in a Vulnerability Assessment. |
| Vulnerability Analysis | Application | The means to determine and assign vulnerabilities and vulnerability assessments for key assets, critical assets, key persons or conveyances (and associated routes). Means of analysis may consist of: (data) mine, integrate, correlate, extrapolate, and analyze data for patterns, densities, trends, networks, tendencies, indicators, hypotheses and conclusions, which pertains or may pertain to vulnerabilities. May also involve geoparsing and geocoding functions to scan and annotate associated textual data for geographic and temporal references. |
| Vulnerability Assessments | Data | The modeling and analysis results from Vulnerability Analysis, as it pertains to key and critical assets. |
| Warning | Data | An expression of threat to those who need to know. A (warning) message that is indicative of a current or predicted threat, based upon modeling, analysis, and/or correlation with one or more incident(s), occurrence(s) or observation(s). |

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| Warning/Alert Management | Application | The monitoring and processing of Alerts in a geospatial-temporal context. The means to generate Warnings. |
| Watch | Function | A function that determines Alerts, which are triggered by any suspicious or threatening event with geospatial and temporal context, as determined by evaluating observed or computed conditions. |
| Watch | Data | A "lookout" notice for a person, goods, conveyance, activity, etc. of interest that contains geospatial and temporal context for a Watch Area. |
| Waterway Management | Application | The means to perform waterways management to provide a safe, efficient and navigable waterway system to support domestic commerce, international trade and military sealift. Provide long-range and short-range aids to navigation (buoys/sensors/breaking ice), electronic charting and tide/current/pilotage information through Notices to Mariners services, weather services, vessel traffic services, technical assistance and advice, vessel safety standards and inspection, and bridge administration standards and inspections. |
| Weather | Data | Weather conditions at specified locations. Hindcasts, nowcasts, forecasts and climate data. |
| Weather Alerts & Warnings | Data | A warning or alert message that is indicative of a current or predicted storm threat, based upon modeling, analysis, and/or correlation with one or more incident(s), occurrence(s) or observation(s). |
| Weather Model | Data | Models that characterize the behaviors of weather systems and the effects of these systems. These models are associated with weather simulations that are influenced by terrain and features. Input to these models consists of terrain and feature data, meteorological sensor observations and model control parameters. Outputs consist of hindcast, nowcast and forecast weather conditions and climate at specified locations. |
| Weather Modeling & Analysis | Application | The means to model/simulate and analyze weather conditions at specified locations. The means to determine hindcasts, nowcasts and forecasts for a location and share this information with agency users. The means to generate and disseminate Weather Alerts & Warnings. |
| Weather Service | Technology | The means to access weather conditions for an area of interest or location for a specified time period. |
| Web Annotation Service | Technology | The Web Annotation Service is a specialized WFS that accesses map/image annotations. It is based upon the XML for Image and Map Annotation (XIMA), which defines an XML vocabulary to encode annotations on imagery, maps, and other geospatial data. This vocabulary draws on the GML to express the positions of these annotations in geographic (real world) or image-pixel coordinates, and to associate each annotation with the geospatial resource(s) it describes. The XIMA encoding is useful for any activity that requires linking or tagging geospatial data in order to present and discuss it with others, to make joint decisions, or to communicate spatially. |
| Web Coverage Service (WCS) | Technology | Able to access geospatial coverage data (e.g., imagery and Digital Terrain Model (DTM)). WCS supports the networked interchange of geospatial data as "coverages" containing values or properties of geographic locations. Unlike the Web Map Service (WMS), which filters and portrays spatial data to return static maps (server-rendered as pictures), the WCS provides access to intact (unrendered) geospatial information, as needed for client-side rendering, multi-valued coverages (such as multi-spectral images and terrain models), and input into scientific models and other clients beyond simple viewers. |
| Web Feature Service (WFS) | Technology | The WFS supports the query and discovery of geographic features (represented in vector form). In a typical Web access scenario, Web Feature Service (WFS) delivers Geography Markup Language (GML) representations of geospatial features. Clients (service requestors/consumers) access geographic feature data through a WFS by submitting a query for just those features that are needed for |

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| | | an application. The client generates a request and posts it to a WFS server on the Web. The WFS instance executes the request, returning the resulting geographic features to the client encoded in GML. A GML-enabled client can manipulate or operate on the returned geographic features. |
| Web Map Service (WMS) | Technology | A WMS is able to access vector and raster data and render it in the form of a map for display (combines access and portrayal). Independent of whether the underlying data are features (point, line and polygon) or coverages (such as gridded digital terrain model or images), the WMS produces an image of the data that can be directly viewed in a web browser or other picture-viewing software. A WMS labels its data as one or more "Layers," each of which is available in one or more "Styles." Upon request a WMS makes an image of the requested Layer(s), in either the specified or default rendering Style(s). Typical output formats include Portable Network Graphics (PNG), Graphics Interchange Format (GIF), Joint Photographic Expert Group format (JPEG), and Tagged Image File Format (TIFF). |
| Web Notification Service | Technology | A service by which a client may conduct a dialog with one or more other services. This service is useful when many collaborating services are required to satisfy a client request, and/or when significant delays are involved is satisfying the request, which is often the case in the geoprocessing realm. |
| Web Registry Service (WRS) | Technology | The WRS provides a common mechanism to classify, register, describe, search, maintain and access information about geospatial resources available on a network. Resources are network addressable instances of typed data or services. Types of registries are differentiated by their role such as registries for cataloging geospatial resource types (e.g., types of geographic features, coverages, sensors, symbols, services, etc), online data instances (e.g., geospatial and image datasets and repositories, application schema, and symbol-style libraries), and online instances of services. |
| Web Terrain Service (WTS) | Technology | The WTS extends the WMS interface to allow the access and portrayal of three dimensional geospatial data. This service can be exploited to perform tasks such as terrain analysis, mission planning, and fly-throughs. |

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# Appendix G: Geospatial Service Components

This appendix lists the set of geospatial service components that might apply within an agency Services Architecture. This list will be updated periodically to reflect changes as they become known by the GEA COP WG. Please see the following page for the most up-to-date listing:

http://colab.cim3.net/cgi-bin/wiki.pl?GeoSpatialCommunityofPractice/GeospatialServiceComponents

To submit a modification to this list, send an electronic mail with the Subject, "Geospatial Service Components Modification Request" to geo-forum@colab.cim3.net. In the content of the electronic mail include the following information:

- Requesting Organization—the name of the organization making the change request.
- Requesting POC Name—the name of a cognizant point of contact with the requesting organization.
- Requesting POC Telephone—the telephone number of a cognizant point of contact with the requesting organization.
- Requesting POC Email—the electronic mail address of a cognizant point of contact with the requesting organization.
- Modification Type—one of Update (to update an existing entry), Insert (to add a new entry), Delete (to delete an existing entry)
- FEA Service Domain—the FEA service domain for the entry
- FEA Service Type—the FEA service type for the entry
- FEA Service Component—the name for the FEA service component entry
- FEA Service Component Description—the description for the FEA service component entry
- Geospatial Service Component—the name for the geospatial service component entry
- Geospatial Service Component Description—the description for the geospatial service component entry
- Component Granularity Level—the component granularity level for the entry (must be BCS, BC, or DC, as defined in section 6.2.1.1)
- Justification—text that justifies the modification requested.
- Implications—text that describes any implications of note that would result from acceptance of the modification (e.g., this change will require the deletion of another entry, the addition of another entry, or similar)

A separate Geospatial Service Components Modification Request should be made for each desired modification. All requests will be registered for processing at the next meeting of the GEA COP WG.

| FEA Service Domain | FEA Service Type | FEA Service-Component | FEA Service Component Description | Geospatial Service Component (* - multiple entries) | Geospatial Service Component Description | Component Granularity Level |
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| Back Office Services Domain | Assets - Materials Management | Facilities Management | Defines the set of capabilities that support the construction, management and maintenance of facilities for an organization. | Facilities Management System | A GIS-based Facilities Management System. | BCS |
| Back Office Services Domain | Assets - Materials Management | Property - Asset Management | Defines the set of capabilities that support the identification, planning and allocation of an organization's physical capital and resources. | Property - Asset Management System | A GIS-based Property - Asset Management System. | BCS |
| Back Office Services Domain | Data Management | Data Exchange | Support the interchange of information between multiple systems or applications; includes verification that transmitted data was received unaltered. | Geospatial Data Exchange and Translation Services | 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. | DC |
| Back Office Services Domain | Data Management | Data Exchange | Support the interchange of information between multiple systems or applications; includes verification that transmitted data was received unaltered. | Coordinate Transformation Service | The ability to transform geospatial data between different coordinate reference systems, datums and units. Support map re-projections on-the-fly for map viewing, as well as permanent coordinate transformations that result in a transformed output data set. | DC |
| Back Office Services Domain | Data Management | Data Exchange | Support the interchange of information between multiple systems or applications; includes verification that transmitted data was received unaltered. | Geospatial Information Broker | A key component used in moving geospatial data between systems. Involved in data sharing and collaboration operations. Involved in Geospatial Data Roll-up/Roll-down Operations. | BC |
| Back Office Services Domain | Data Management | Extraction and Transformation | Defines the set of capabilities that support the manipulation and change of data. | Feature Update Service | An application and supporting services for selection, browsing, extraction, transformation, integration and update of a feature database. Assures that requestor credentials are sufficient | BC |

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| | | | | | for requested changes and that changes requested do not violate validation rules. | |
| Back Office Services Domain | Data Management | Extraction and Transformation | Defines the set of capabilities that support the manipulation and change of data. | Coverage Update Service | An application and supporting services for selection, browsing, transformation, integration and update of a coverage (e.g., imagery) database. Assures that requestor credentials are sufficient for requested changes and that changes requested do not violate validation rules. | BC |
| Back Office Services Domain | Data Management | Extraction and Transformation | Defines the set of capabilities that support the manipulation and change of data. | Gazetteer Update Service | An application and supporting services to support browsing, data entry, transformation, integration and update of a gazetteer database. Supports adding, changing, and deleting gazetteer records. Assures that requestor credentials are sufficient for requested changes and that changes requested do not violate validation rules. | BC |
| Back Office Services Domain | Data Management | Extraction and Transformation | Defines the set of capabilities that support the manipulation and change of data. | Geospatial Resource Metadata (Catalog) Update Service | An application and supporting services for browsing, data entry, transformation, integration and update of the metadata for geospatial resources, and optionally, update of associated geospatial resource records. (Geospatial resources include maps and data from which maps may be derived, and may include ancillary products and services. A Geospatial Catalog includes various ways by which geospatial resources are characterized and associated.) Assures that requestor credentials are sufficient for requested changes and that changes requested do not violate validation rules. Accesses one or more Resource Catalog Servers. | BC |
| Back Office Services Domain | Data Management | Extraction and Transformation | Defines the set of capabilities that support the manipulation and change of data. | Geospatial Service Metadata (Catalog) Update Service | An application and supporting services for browsing, data entry, integration and update of the metadata for geospatial services. Assures that requestor credentials are sufficient for requested changes and that changes requested do not violate validation rules. Accesses one or more Service Catalog Servers. | BC |
| Back Office Services | Data Management | Geographic Data | A general-purpose set of capabilities for extracting, loading, transforming, | Geographical Information | An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, | BCS |

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| Domain | | Management (GIS) 45 | integrating, storing, archiving and managing geospatial information and related metadata. | System* | manipulating, visualizing, analyzing and otherwise exploiting Geospatial Information. GIS focuses on producing and exploiting "digital maps" that convey Geospatial Information in graphical form. It is used widely in government, education and business.<br><br>Also, a general-purpose collection of tools for processing geospatial data. Normally consists of one or more applications with one or more databases. May be configured as a desktop application and/or as a collection of client and server components. | |
| Back Office Services Domain | Data Management | Geographic Data Management (GIS) | A general-purpose set of capabilities for extracting, loading, transforming, integrating, storing, archiving and managing geospatial information and related metadata. | GIS Server* | Comprised of one or more bundled geospatial processing services that support the generation, revision, management, processing, and output of geospatial data. Server-based GIS. | DC |
| Back Office Services Domain | Data Management | Geographic Data Management (GIS) | A general-purpose set of capabilities for extracting, loading, transforming, integrating, storing, archiving and managing geospatial information and related metadata. | Native Geospatial DBMS Server | The capabilities for an Enterprise DBMS to provide native support for storing and managing all types of geospatial data. Capabilities should include geospatial indexing, open SQL query support with geometry and topology operators, geospatial analytics, geospatial data mining, | DC |

[45] A complex Business Component System such as a GIS, featured here, does not fit neatly under the FEA SRM taxonomy. GIS cuts across many FEA Service Domains and Types. We have created a new Geospatial Service Component, GIS, here and elsewhere, to reflect the predominant role of GIS in an enterprise.

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| | | | | | coordinate transformation and linear referencing. | |
| Back Office Services Domain | Data Management | Imagery Data Management (GIS) 46 | A general-purpose set of capabilities for extracting, loading, transforming, integrating, storing, archiving and managing geospatial imagery and related metadata. | Imagery Processing System (IPS)* | An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, manipulating, visualizing, analyzing and otherwise exploiting Geospatial Imagery. IPS focuses on producing and exploiting "digital orthoimagery" that conveys Geospatial Information in raster image form. It is used widely in government, education and business.<br><br>Also, a general-purpose collection of tools for processing geospatial imagery. Normally consists of one or more applications with one or more databases. May be configured as a desktop application and/or as a collection of client and server components. | BCS |
| Back Office Services Domain | Data Management | Imagery Data Management (GIS) | A general-purpose set of capabilities for extracting, loading, transforming, integrating, storing, archiving and managing geospatial imagery and related metadata. | Geospatial Imagery Processing Server* | Comprised of one or more bundled geospatial imagery processing services that support the generation, revision, management, processing, and output of geospatial imagery. Server-based Imagery Processing System. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) 47 | A general-purpose set of capabilities for analyzing and processing geospatial data. | Geographical Information System* | An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, manipulating, visualizing, analyzing and otherwise exploiting Geospatial Information. GIS focuses on producing and exploiting "digital maps" that convey Geospatial Information in graphical form. It is used widely in government, education and business.<br><br>Also, a general-purpose collection of tools for processing geospatial data. Normally consists of one or more applications with one or more databases. May be configured as a desktop application and/or as a collection of client and server components. | BCS |

[46] Likewise, a complex Business Component System such as an Imagery Processing System (IPS), featured here, does not fit neatly under the FEA SRM taxonomy: IPS cuts across many FEA Service Domains and Types. We have created a new Geospatial Service Component, IPS, here and elsewhere, to reflect the predominant role of IPS in an enterprise.

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| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | GIS Server* | Comprised of one or more bundled geospatial processing services that support the generation, revision, management, processing, and output of geospatial data. Server-based GIS. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Geocoder/ Reverse Geocoder Service | Able to determine geospatial coordinates, given an address (Geocoder), or determine address, given geospatial coordinates (Reverse Geocoder). A Geocoder 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 Geocoder 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 Geocoder Service, such as a street addressing or postal coding scheme. These services are very important across many enterprises, as they enable enterprise users to exploit the geospatial-temporal context of the wide diversity of business data that contain Location References, such as address, building name, census tract, etc. They are also key to correlating, integrating and fusing dissimilar data on the basis of geospatial-temporal characteristics. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Geolocate Service | The capability to use GPS or some other means to determine a geospatial location for a fixed or mobile object of interest (e.g., geospatial feature, person, asset, conveyance, goods, cargo, device, etc.) Mobile Objects must be equipped with GPS, Radio Frequency ID (RFID), and/or other position determination technologies. | DC |
| Business | Analysis and | Geographic | A general-purpose set of capabilities for | Gateway | Determines the geospatial position of a known | DC |

[47] A complex Business Component System such as a GIS, featured here, does not fit neatly under the FEA SRM taxonomy. GIS cuts across many Service Domains and Types. We have created a new Geospatial Service Component, GIS, here and elsewhere, to reflect the predominant role of GIS in an enterprise.

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| Analytical Services Domain | Statistics | Analysis (GIS) | analyzing and processing geospatial data. | Service | mobile terminal from a wireless network. Position is expressed in geographic coordinates. Mobile terminals (cell phones, PDAs, etc) must be equipped with GPS or some other position determination technology. An important service used in LBS, in the wireless realm. | |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Route Service | Able to determine (or fetch a predetermined) route and navigation information for autonomous or semi-autonomous navigation between two or more points on a network. An important service used in LBS, in the wireless realm. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Navigation Service | An enhanced version of the Route Service, which determines routes between two or more points with enhanced navigation information. An important service used in LBS. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Monitoring Service | Able to determine (or fetch a predetermined) location/time/identity/ status/ activity series for a Location. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Tracking Service | Able to determine (or fetch a predetermined) location/time/velocity/identity/status/activity series (track) for a mobile object (e.g., persons, goods, assets, devices, etc.) | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Weather Service | The means to access weather conditions for an area of interest or location for a specified time period. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Traffic Service | The means to access traffic information regarding incidents and/or conditions for a specified area of interest, road, or road segment, for a specified time period. Also, the means to access traffic information regarding incidents and/or conditions for a designated route (that has been determined by a Route Service or Navigation Service) for a specified time period. | DC |
| Business Analytical | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial | Model Service | Able to determine and access the extent and nature of a geospatial model (e.g., Toxic | DC |

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| Services Domain | | | data. | | 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. | |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Geoparser Service | Geoparsing refers to the capability to scan and parse a textual document, identifying key words and phrases that have geospatial-temporal context. A Geoparser Service works in the context of two bodies of information: a reserved vocabulary (a dictionary of place names, a gazetteer or a directory of points of interest (POIs) and a text source (e.g., a newspaper or cable.). The Geoparser returns all occurrences of the use (in the text source) of any term in the reserved vocabulary. Each occasion establishes a geolinks (geospatial/temporal-aware hyperlink) between text terms and the geospatial location associated with the reserved word. That result is an annotated text document with geolinks. | DC |
| Business Analytical | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial | Sensor Planning | A service by which a client[48] can determine sensor collection feasibility for a desired set of | DC |

[48] Client, as used here, means any software component or application that invokes a service.

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| Services Domain | | | data. | Service | collection requests for one or more mobile sensors/platforms, or the client may submit collection requests directly to these sensors/platforms. | |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Sensor Observation Service | A service by which a client can obtain observations from one or more sensors/platforms (can be mixed types). Clients can also obtain information that describes the associated sensors and platforms. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Sensor Alert Service | The SASs produce alert messages when given observation conditions are met by a sensor. Provides the means for client services/users to specify and register user profiles that contain user information, applicable sensors/observations, alert conditions (e.g., maximum/minimum values), and alert actions (what happens if conditions are met). Also, the means for client services/users to update user profiles. Clients are able to control the nature of alerts. For example, a client is able to activate/deactivate an alert capability. Also provides the means to support push/pull capabilities, e.g., to wait for observation input from associated sensors (for on/off sensors like a detector), or to actively poll for (current/historical/predicted) sensor observations. | DC |
| Business Analytical Services Domain | Analysis and Statistics | Geographic Analysis (GIS) | A general-purpose set of capabilities for analyzing and processing geospatial data. | Topology Service | The ability to detect topology errors (e.g., overshoots and undershoots of common linear and polygonal features within a definable tolerance), automatically correct errors, if possible, and define topological relationships between connected/collocated linear, polygon, and point features. | DC |
| Business Analytical | Analysis and Statistics | Imagery Analysis (IPS)[49] | A general-purpose set of capabilities for analyzing and processing geospatial | Imagery Processing | An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, | BCS |

[49] Likewise, a complex Business Component System such as an Imagery Processing System (IPS), featured here, does not fit neatly under the FEA SRM taxonomy. IPS cuts across many FEA Service Domains and Types. We have created a new Geospatial Service Component, IPS, here and elsewhere, to reflect the predominant role of IPS in an enterprise.

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| Services Domain | | | imagery and related metadata. | System (IPS)* | manipulating, visualizing, analyzing and otherwise exploiting Geospatial Imagery. IPS focuses on producing and exploiting "digital orthoimagery" that conveys Geospatial Information in raster image form. It is used widely in government, education and business.<br><br>Also, a general-purpose collection of tools for processing geospatial imagery. Normally consists of one or more applications with one or more databases. May be configured as a desktop application and/or as a collection of client and server components. | |
| Business Analytical Services Domain | Analysis and Statistics | Imagery Analysis (IPS) | A general-purpose set of capabilities for analyzing and processing geospatial imagery and related metadata. | Geospatial Imagery Processing Server* | Comprised of one or more bundled geospatial imagery processing services that support the generation, revision, management, processing, and output of geospatial imagery. Server-based Imagery Processing System. | DC |
| Business Analytical Services Domain | Knowledge Discovery | Simulation | Defines the set of capabilities that support the representation of the interaction between real-world objects. | Terrain Simulator | The application and supporting services for viewing 3D geospatial information. Many specialized types of this service. Accesses one or more Terrain Servers. | BC |
| Business Analytical Services Domain | Reporting | Ad-Hoc | Ad Hoc - defines the set of capabilities that support the use of dynamic reports on an as needed basis. | Location Report Generator* | The application and supporting services for composing a report based upon location-based (geospatial) information. Many specialized types of this service, e.g., situation reports, after action reports, alert/warning reports, incident reports, activity reports, etc. | BC |
| Business Analytical Services Domain | Reporting | Standardized - Canned | Defines the set of capabilities that support the use of pre-conceived or pre-written reports. | Location Report Generator* | The application and supporting services for composing a report based upon location-based (geospatial) information. Many specialized types of this service, e.g., situation reports, after action reports, alert/warning reports, incident reports, activity reports, etc. | BC |
| Business Analytical | Visualization | Imagery | Defines the set of capabilities that support the creation of film or | Coverage Client* | An application that provides the means to visualize and interact with Coverages (e.g., | BC50 |

[50] May come bundled with one or more Coverage Servers, and/or may be more open-ended and integrate with one or more Distributed Component Coverage Servers.

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| Services Domain | | | electronic images from pictures, paper forms or graphics for static or dynamic use. | | geospatial imagery and raster data). Provides tools to select Coverage data for viewing, enhancement, annotation layer control, setting view window, display chosen view, coordinate transformation, measure and pinpoint, navigate through view with pan and zoom, etc. Usually associated with one or more Coverage Servers. | |
| Business Analytical Services Domain | Visualization | Imagery | Defines the set of capabilities that support the creation of film or electronic images from pictures, paper forms or graphics for static or dynamic use. | Annotation Service* | A service that accesses map/image annotations. Annotations are useful for any activity that requires linking or tagging geospatial data in order to present and discuss it with others, to make joint decisions, collaborate or to communicate spatially. | DC |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS[51] | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Map(ping) Client | An application that provides the means to visualize and interact with geospatial data in rendered map form. Provides tools to select base map/image data for viewing, layer control (e.g., 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 symbology, map display template or select previous views. Usually associated with one or more Map Servers. | BC52 |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Situation Awareness | An application and associated services for viewing an area of interest, incident or event in a geospatial context. May include related geospatial services for selection, analysis, manipulation, reporting, collaboration, etc. | BC |
| Business Analytical Services | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, | Coverage Client* | An application that provides the means to visualize and interact with Coverages (e.g., geospatial imagery and raster data). Provides | BC53 |

[51] This is the only reference having to do with geospatial in the entire FEA SRM, version 1.0. Recommend that this FEA Service Component be changed to "Geospatial Visualization", described as "Provide for the representation of geospatial information."

[52] May come bundled with one or more Map Servers, and/or may be more open-ended and integrate with one or more Distributed Component Map Servers.

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| Domain | | | and longitude coordinates | | tools to select Coverage data for viewing, enhancement, annotation layer control, setting view window, display chosen view, coordinate transformation, measure and pinpoint, navigate through view with pan and zoom, etc. Usually associated with one or more Coverage Servers. | |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Feature Client | Sends requests to one or more Feature Servers for detailed information pertaining to a particular feature within a map. Provides the means to visualize Feature information. Provides tools to query Feature data, display chosen view, and designate target coordinate transformation system. Often combined with Map Client. | BC54 |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Personal Map Software | Personal Map Software includes a variety of tools for viewing, annotating and manipulating map data. Typically include map data for standalone operations. Often includes Global Positioning System (GPS) capability for mobile applications. Commercial map software for desktop or Personal Digital Assistant (PDA). | BC |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Geospatial Client | An application that provides the means to visualize and interact with a variety of geospatial data, including Maps, Features and Coverages. Provides tools to select data for viewing, enhancement, annotation layer control, setting view window, display chosen view, coordinate transformation, measure and pinpoint, navigate through view with pan and zoom, etc. Usually associated with one or more geospatial data servers. | BC55 |
| Business | Visualization | Mapping, | Provide for the representation of | Specialized | Geospatial-based business applications and | BC56 |

[53] May come bundled with one or more Coverage Servers, and/or may be more open-ended and integrate with one or more Distributed Component Coverage Servers.

[54] May come bundled with one or more Feature Servers, and/or may be more open-ended and integrate with one or more Distributed Component Feature Servers.

[55] May come bundled with one or more geospatial data servers, and/or may be more open-ended and integrate with one or more Distributed Component servers.

[56] May come bundled with one or more geospatial data servers, and/or may be more open-ended and integrate with one or more Distributed Component servers.

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| Analytical Services Domain | | geospatial (GIS), elevation, GPS | position information through the use of attributes such as elevation, latitude, and longitude coordinates | Geospatial Business Components (Various) | associated services that provides visualization and interaction with geospatial data. Provides access to underlying Business Components and Geospatial Services. Many such Specialized Geospatial Business Components will exist within enterprises, each which may have a client application and one or more Business Components and/or Geospatial Services. | |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Location Client* | Sends requests to one or more Location Servers for a) geo-coding an address, yielding a coordinate; b) reverse geo-coding a coordinate, returning an address; c) routing from a start point to and end point (perhaps with intervening via points); d) a point of interest given a coordinate or an address (either precisely or within a proximity). Provides the means to visualize location information. Provides tools to query location data and display chosen view, often on a map. Normally implemented as wireless, Location-based Services (LBS). | BC57 |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Gazetteer Client | Sends requests to one or more Gazetteer Servers a for place names by a given location or for locations by a given place name. Provides the means to visualize gazetteer information. Provides tools to query gazetteer data and display chosen view. Often combined with other clients. | BC58 |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Style Management Service (SMS) | The means to create update and manage styles and symbols. The SMS must manage distinct objects that represent styles and symbols and provide the means to discover, query, insert, update, and delete these objects. Styles provide the mapping from feature types and feature properties and constraints to parameterized Symbols used in drawing maps. Symbols are bundles of predefined graphical parameters and | BC |

[57] May come bundled with one or more Location Servers, and/or may be more open-ended and integrate with one or more Distributed Component servers.

[58] May come bundled with one or more Gazetteer Servers, and/or may be more open-ended and integrate with one or more Distributed Component servers.

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| | | | | | predefined fixed graphic "images". | |
| Business Analytical Services Domain | Visualization | Mapping, geospatial (GIS), elevation, GPS | Provide for the representation of position information through the use of attributes such as elevation, latitude, and longitude coordinates | Annotation Service* | A service that accesses map/image annotations. Annotations are useful for any activity that requires linking or tagging geospatial data in order to present and discuss it with others, to make joint decisions, collaborate or to communicate spatially. | DC |
| Business Management Services Domain | Supply Chain Management | Catalog Management | Defines the set of capabilities that support the listing of available products or services that an organization offers. | Services Catalog Client | An application that sends requests to one or more Service Catalog Servers for geospatial service catalog records. Includes tools to select and view this information. | BC |
| Business Management Services Domain | Supply Chain Management | Catalog Management | Defines the set of capabilities that support the listing of available products or services that an organization offers. | Resources Catalog Client | An application that sends requests to one or more Resource Catalog Servers for geospatial resource catalog records. Includes tools to select and view this information. (Geospatial resources include maps and data from which maps may be derived, and may include ancillary products and services. A geospatial catalog includes various ways by which geospatial resources are characterized and associated.) | BC |
| Business Management Services Domain | Supply Chain Management | Catalog Management | Defines the set of capabilities that support the listing of available products or services that an organization offers. | Location Client* | Sends requests to one or more Location Servers for information about a point of interest (e.g., store) and associated products and services. Provides capabilities to support a) geo-coding an address, yielding a coordinate; b) reverse geo-coding a coordinate, returning an address; c) routing from a start point to and end point (perhaps with intervening via points); d) a point of interest given a coordinate or an address (either precisely or within proximity). Provides the means to visualize point of interest information. Provides tools to query point of interest data and display chosen view, often on a map. Normally implemented as wireless, Location-based Services (LBS). | BC |

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| Digital Asset Services Domain | Content Management | Map Production (GIS) 59 | A general-purpose set of capabilities for authoring, publishing and sharing softcopy and hardcopy digital map data. | Geographical Information System* | An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, manipulating, visualizing, analyzing and otherwise exploiting Geospatial Information. GIS focuses on producing and exploiting "digital maps" that convey Geospatial Information in graphical form. It is used widely in government, education and business.<br><br>Also, a general-purpose collection of tools for processing geospatial data. Normally consists of one or more applications with one or more databases. May be configured as a desktop application and/or as a collection of client and server components. | BCS |
| Digital Asset Services Domain | Content Management | Map Production (GIS) | A general-purpose set of capabilities for authoring, publishing and sharing softcopy and hardcopy digital map data. | 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. | BC |
| Digital Asset Services Domain | Content Management | Map Production (GIS) | A general-purpose set of capabilities for authoring, publishing and sharing softcopy and hardcopy digital map data. | GIS Server* | Comprised of one or more bundled geospatial processing services that support the generation, revision, management, processing, and output of geospatial data. Server-based GIS. | DC |
| Digital Asset Services Domain | Content Management | Imagery Production (IPS) 60 | A general-purpose set of capabilities for authoring, publishing and sharing softcopy and hardcopy geospatial imagery data. | Imagery Processing System (IPS)* | An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, manipulating, visualizing, analyzing and otherwise exploiting Geospatial Imagery. IPS focuses on producing and exploiting "digital orthoimagery" that conveys Geospatial Information in raster image form. It is used widely in government, education and business.<br><br>Also, a general-purpose collection of tools for processing geospatial imagery. Normally consists | BCS |

[59] A complex Business Component System such as a GIS, featured here, does not fit neatly under the FEA SRM taxonomy. GIS cuts across many Service Domains and Types. We have created a new Geospatial Service Component, GIS, here and elsewhere, to reflect the predominant role of GIS in an enterprise.

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| | | | | | of one or more applications with one or more databases. May be configured as a desktop application and/or as a collection of client and server components. | |
| Digital Asset Services Domain | Content Management | Imagery Production (IPS) | A general-purpose set of capabilities for authoring, publishing and sharing softcopy and hardcopy geospatial imagery data. | Geospatial Imagery Processing Server* | Comprised of one or more bundled geospatial imagery processing services that support the generation, revision, management, processing, and output of geospatial imagery. Server-based Imagery Processing System. | DC |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Feature Server | Responds to requests from a feature client for detailed information pertaining to a particular feature within a map. Optionally supports coordinate transformation from a source coordinate reference system to a target coordinate reference system. | DC |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Coverage Server | Responds to requests from a coverage client to deliver a rendered orthoimage/map. Optionally supports coordinate transformation from a source coordinate reference system to a target coordinate reference system. May act as a proxy to multiple remote coverage services to return a single composite orthoimage/map. | DC |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Map(ping) Server | The means to render 2D views of geospatial data. Responds to requests from a map client to deliver a rendered map. Supports coordinate transformation from a source coordinate reference system to a target coordinate reference system. Supports the specification of remote layer styles. May act as a proxy to multiple remote map services to return a single composite map. | DC |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Terrain Server | The means to render 3D views of geospatial data. Responds to requests from a Terrain Simulator to deliver a rendered 3D data. Supports coordinate transformation from a source coordinate | DC |

[60] Likewise, a complex Business Component System such as an Imagery Processing System (IPS), featured here, does not fit neatly under the FEA SRM taxonomy. IPS cuts across many FEA Service Domains and Types. We have created a new Geospatial Service Component, IPS, here and elsewhere, to reflect the predominant role of IPS in an enterprise.

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| | | | | | reference system to a target coordinate reference system. Supports the specification of layer styles. May act as a proxy to multiple remote terrain services to return a single composite view. | |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Gazetteer Server | Responds to Gazetteer Client requests for place names by a given location or for locations by a given place name. | DC |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Location Server | A service with multiple functions that responds to Location Client requests for a) geo-coding an address, yielding a coordinate; b) reverse geo-coding a coordinate, returning an address; c) routing from a start point to and end point (perhaps with intervening via points); d) a point of interest given a coordinate or an address (either precisely or within a proximity). Normally implemented as wireless, Location-based Services (LBS). | DC |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Resource Catalog Server* (or Registry Service) | Responds to client requests for geospatial resource metadata. (Geospatial resources include maps and data from which maps may be derived, and may include ancillary products and services. A geospatial catalog includes various ways by which geospatial resources are characterized and associated.) | DC |
| Digital Asset Services Domain | Knowledge Management | Information Sharing | Defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders. | Service Catalog Server* | Responds to client requests for geospatial service metadata. | DC |

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# Appendix H: Geospatial Standards List

This appendix lists the set of geospatial standards that might apply within an agency Technology Architecture. This list will be updated periodically to reflect changes as they become known by the GEA COP WG. Please see the following page for the most up-to-date listing:

http://colab.cim3.net/cgi-bin/wiki.pl?GeoSpatialCommunityofPractice/GeospatialStandardsList

To submit a modification to this list, send an electronic mail with the Subject, "Geospatial Standards List Modification Request" to geo-forum@colab.cim3.net. In the content of the electronic mail include the following information:

- Requesting Organization—the name of the organization making the change request.
- Requesting POC Name—the name of a cognizant point of contact with the requesting organization.
- Requesting POC Telephone—the telephone number of a point of contact with the requesting organization.
- Requesting POC Email—the electronic mail address of a point of contact with the requesting organization.
- Modification Type—one of Update (to update an existing entry), Insert (to add a new entry), Delete (to delete an existing entry)
- Organization—the organization entry for the standard affected by the modification
- Nickname—the nickname entry for the standard affected by the modification
- Title—the title entry for the standard affected by the modification
- Revision—the revision entry for the standard affected by the modification
- Description—the description entry for the standard affected by the modification
- Justification—text that justifies the modification requested.
- Implications—text that describes any implications of note that would result from acceptance of the modification (e.g., this change will require the deletion of another entry, the addition of another entry, or similar)

A separate Geospatial Standards List Modification Request should be made for each desired modification. All requests will be registered for processing at the next meeting of the GEA COP WG.

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| Org. | Nickname | Title | Rev. | Description |
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| OGC | ORM | OGC Reference Model | 0.1.3 | The ORM describes a framework for the ongoing work of the Open Geospatial Consortium and our specifications and implementing interoperable solutions and applications for geospatial services, data, and applications |
| OGC | Common | OGC Web Services Common | 1.0 | Specifies many of the aspects that are, or should be, common to all or multiple OWS interface Implementation Specifications. Those specifications currently include the Web Map Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS). These common aspects include: operation request and response contents; parameters included in operation requests and responses; and encoding of operation requests and responses. |
| OGC | WFS | Web Feature Service | 1.1 | The OGC Web Map Service allows a client to overlay map images for display served from multiple Web Map Services on the Internet. In a similar fashion, the OGC Web Feature Service allows a client to retrieve and update geospatial data encoded in Geography Markup Language (GML) from multiple Web Feature Services. The requirements for a Web Feature Service are: 1. The interfaces must be defined in XML. 2. GML must be used to express features within the interface. 3. At a minimum a WFS must be able to present features using GML. 4. The predicate or filter language will be defined in XML and be derived from CQL as defined in the OpenGIS Catalogue Interface Implementation Specification. 5. The data store used to store geographic features should be opaque to client applications and their only view of the data should be through the WFS interface. The use of a subset of XPath expressions for referencing properties. |
| OGC | Filter | Filter Encoding | 1.1 | Filter Encoding (Filter): defines an XML encoding for filter expressions based on the BNF definition of the OpenGIS Common Catalog Query Language as described in the OpenGIS Catalog Interface Implementation Specification, Version 1.0. |
| OGC | WMC | Web Map Context Documents | 1.1 | A companion specification to the OGC Web Map Service Interface Implementation Specification version 1.1.1, hereinafter "WMS 1.1.1." WMS 1.1.1 specifies how individual map servers describe and provide their map content. The present Context specification states how a specific grouping of one or more maps from one or more map servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. This description is known as a "Web Map Context Document," or simply a "Context." Presently, context documents are primarily designed for WMS bindings. However, extensibility is envisioned for binding to other services. A Context document includes information about the server(s) providing layer(s) in the overall map, the bounding box and map projection shared by all the maps, sufficient operational metadata for Client software to reproduce the map, and ancillary metadata used to annotate or describe the maps and their provenance for the benefit of human viewers. A Context document is structured using eXtensible Markup Language (XML). Annex A of this |

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| | | | | specification contains the XML Schema against which Context XML can be validated |
| OGC | OpenLS | OpenGIS Location Services | 1.0 | This OpenGIS Implementation Specification describes OpenGIS Location Services (OpenLS): Core Services, Parts 1-5, also known as the GeoMobility Server (GMS), an open platform for location-based application services. It also outlines the scope and relationship of OpenLS with respect to other specifications and standardization activities. The primary objective of OpenLS is to define access to the Core Services and Abstract Data Types (ADT) that comprise the GeoMobility Server, an open location services platform. |
| OGC | CAT | Catalog Interface | 2.0 | Catalog Interface: Defines a common interface that enables diverse but conformant applications to perform discovery, browse and query operations against distributed and potentially heterogeneous catalog servers. |
| OGC | WMS | Web Mapping Service | 1.3 | Provides three operations (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple sources that are both remote and heterogeneous. |
| OGC | WCS | Web Coverage Service | 1.0 | Extends the Web Map Server (WMS) interface to allow access to geospatial "coverages" that represent values or properties of geographic locations, rather than WMS generated maps (pictures). |
| OGC | GML | Geography Markup Language | 3.1.1 | The Geography Markup Language (GML) is an XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features. |
| OGC | SLD | Styled Layer Descriptor | 1.0 | The SLD is an encoding for how the Web Map Server (WMS 1.0 & 1.1) specification can be extended to allow user-defined symbolization of feature data. |
| OGC | Grid | Grid Coverage Service | 1.0 | This specification was designed to promote interoperability between software implementations by data vendors and software vendors providing grid analysis and processing capabilities. |
| OGC | CT | Coordinate Transformation Services | 1.0 | Provides interfaces for general positioning, coordinate systems, and coordinate transformations. |
| OGC | SF | Simple Features - SQL, CORBA, OLE/COM | 1.1, 1.0, 1.1 | The Simple Feature Specification application programming interfaces (APIs) provide for publishing, storage, access, and simple operations on Simple Features (point, line, polygon, multi-point, etc). |
| OGC | SensorML | Sensor Model Language for In-situ and Remote Sensors | 1.0 | The Sensor Model Language work proposes an XML schema for describing the geometric, dynamic, and observational characteristics of sensor types and instances. |
| OGC | SCS | Sensor Collection | 0.5.1 | The basic function of the Sensor Collection Service (SCS) is to provide a web-enabled interface to a sensor, |

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| | | Service | | collection of sensors or sensor proxy. Sensors are defined as devices that measure physical quantities. |
| OGC | Gaz | Gazetteer | 0.8 | A service that serves as an authority for place names, returning their associated geometries. |
| OGC | GeoC | Geocoder | 0.7.6 | Geocoding is the process of linking words, terms and codes found in a text string to their applicable geospatial features, with known locations (locations are defined as geometry; usually points with x, y coordinates). |
| OGC | GeoP | Geoparser | 0.7.1 | Geoparsing refers to the capability to process a textual document and identify key words and phrases that have a spatial context. |
| OGC | XIMA | XML for Image and Map Annotation | 0.4 | Defines an XML vocabulary to encode annotations on imagery, maps, and other geospatial data. This vocabulary draws on the Geography Markup Language (OpenGIS GML Recommendation Paper, Revision 2.0.) |
| OGC | UoM | Units of Measure Recommendation | 1.0 | Common semantic for units of measurement to be used across all OGC specifications. |
| OGC | WTS | Web Terrain Service | 0.3.2 | This document is a companion specification to the OpenGIS Web Map Service Interface Implementation Specification version 1.1.1, hereinafter "WMS 1.1.1." WMS 1.1.1 specifies how individual map servers describe and provide their map content. The present Web Terrain Service specification describes a new operation, GetView, and extended Capabilities which allow a 3D terrain view image to be requested, given a map composition, a terrain model on which to drape the map, and a 3D viewpoint from which to render the terrain view. A simple attempt is also made to reconcile 2D and 3D viewpoints by allowing the requested 3D area of view to be approximated with a WMS 1.1.1 bounding box. |
| OGC | Web3D | Web 3D Service | 0.3.0 | The Web 3D Service is a portrayal service for three-dimensional geodata, delivering graphical elements from a given geographical area. In contrast to the OGC Web Mapping service (WMS) and the OGC Web terrain service (WTS) 3D scene graphs are produced. These scene graphs will be rendered by the client and can interactively be explored by the user. The W3DS merges different types (layers) of 3D data in one scene graph. |
| FGDC | FGDC-STD-001-1998 | Content Standard for Digital Geospatial Metadata | 2.0 | The objectives of the standard are to provide a common set of terminology and definitions for the documentation of digital geospatial data. The standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements. ISO harmonization efforts are underway.<br>http://www.fgdc.gov/metadata/contstan.html |
| FGDC | FGDC-STD-001.1-1999 | Content Standard for Digital Geospatial | | Provides a user-defined or theme-specific profile of the FGDC Content Standard for Digital Geospatial Metadata to increase its utility for documenting biological resources data and information. This standard |

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| | | Metadata, Part 1: Biological Data Profile | | supports increased access to and use of biological data among users on a national (and international) basis. This standard also serves as the metadata content standard for the National Biological Information Infrastructure (NBII). This standard can be used to specify metadata content for the full range of biological resources data and information. This includes biological data which are explicitly geospatial in nature, as well as data which are not explicitly geospatial (such as data resulting from laboratory-based research). This also includes "information" categories, such as research reports, field notes or specimen collections.<br><br>http://www.fgdc.gov/standards/status/sub5_2.html |
| FGDC | FGDC-STD-012-2002 | Content Standard for Digital Geospatial Metadata: Extensions for Remote Sensing Metadata | | These extensions define content standards for additional metadata, not defined in the Metadata Content Standard, that are needed to describe data obtained from remote sensing. They include metadata describing the sensor, the platform, the method and process of deriving geospatial information from the raw telemetry, and the information needed to determine the geographical location of the remotely sensed data. In addition, metadata to support aggregation, both the components of an aggregate data set and the larger collection of which a data item may be a member, will be supported.<br><br>http://www.fgdc.gov/standards/status/csdgm_rs_ex.html |
| FGDC | FGDC-STD-001.2-2001 | Metadata Profile for Shoreline Data | | First in a series of standards that will define a Shoreline Data Content Standard. The metadata profile is to be used as an extension or profile to the existing Content Standards for Digital Geospatial Metadata (CSDGM). Because the CSDGM only allows for the documentation of generic geospatial data, the Bathymetric Subcommittee felt it was necessary to develop a metadata profile that addressed shoreline data and data that intersects with the shoreline. The objective of the metadata profile is to capture the critical processes and conditions that revolve around creating and collecting shoreline data. The metadata produced using this standard will be important for clearinghouse activities to locate potential data sets and to indicate the fitness for use and accuracy of a given data set. This Standard is intended to serve the community of users who are involved with geospatial data “activities” that intersect the U.S. Shoreline. The purpose is to clarify (standardize) some of the complexities of shoreline data by developing a metadata profile, bibliography and glossary, which will be an extension or profile of the FGDC CSDGM.<br><br>http://www.fgdc.gov/standards/status/sub5_6.html |
| FGDC | FGDC-STD-002 | Spatial Data Transfer Standard (SDTS) | | http://mcmcweb.er.usgs.gov/sdts/<br>(a modified version was adopted as ANSI INCITS 320:1998, which is undergoing periodic review through INCITS Technical Committee L1) |
| FGDC | FGDC-STD-002.5 | SDTS Part 5: Raster Profile and Extensions | | Contains specifications of a profile for use with geo-referenced two dimensional raster data, and excludes vector data and three dimensional and higher dimension raster data. It is intended to provide a common transfer format to be used for interchange of raster image and raster grid data among all members of the |

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| | | | | data producer and user community.<br><br>http://www.fgdc.gov/standards/status/sub4_1.html |
| FGDC | FGDC-STD-002.6 | SDTS Part 6: Point Profile | | Contains specifications for a SDTS profile for use with geographic point data only, with the option to carry high precision coordinates (by increasing the number of decimal places or significant figures) such as those required for geodetic network control points can be attained.<br><br>http://www.fgdc.gov/standards/status/sub2_3.html |
| FGDC | FGDC-STD-002.7-2000 | SDTS Part 7: Computer-Aided Design and Drafting (CADD) Profile | | Contains specifications for an SDTS profile for use with vector-based geographic data as represented in CADD software. The purpose of this profile is to facilitate the translation of this data between CADD packages without loss of data, and support the translation of this data between CADD and mainstream GIS packages. This profile supports two-dimensional vector data and three-dimensional vector data, where the third dimension is the "height" of the object. These data may or may not have topology.<br><br>http://www.fgdc.gov/standards/status/sub3_2.html |
| FGDC | FGDC-STD-003 | Cadastral Data Content Standard | | Support the automation and integration of publicly available land records information. It is intended to be useable by all levels of government and the private sector. The standard contains the standardization of entities and objects related to cadastral information including survey measurements, transactions related to interests in land, general property descriptions, and boundary and corner evidence data. Any or all of these applications are intended to be supported by the standard. The standard is not intended to reflect an implementation design.<br><br>http://www.fgdc.gov/standards/status/sub3_5.html |
| FGDC | FGDC-STD-004 | Classification of Wetlands and Deepwater Habitats of the United States | | Provides a system that allows communication about wetlands and their features in a National context. Doing so enhances the ability of all agencies and individuals to interpolate and extrapolate wetland resource data, wetland loss and gain data, and restoration efforts in the same semantic and ecological context. The classification system was developed by wetland ecologists with the assistance of many private individuals and organizations and local, State, and Federal agencies.<br><br>Specific objectives of this standard are to:<br><br>a. provide a nationally consistent definition of wetlands and deepwater habitats for mapping and inventory purposes;<br>b. describe ecological units that have certain homogeneous natural attributes;<br>c. arrange those units in a system that will aid decisions about resource management;<br>d. furnish units for inventory and mapping;<br>e. ensure that data from widely differing regions of the country are collected and can be interpreted similarly; and, |

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| | | | | f. move toward a system that allows communication about wetlands and their features in a National context. Doing so enhances the ability of all agencies and individuals to interpolate and extrapolate wetland resource data, wetland loss and gain data, and restoration efforts in the same semantic and ecological context.<br><br>http://www.fgdc.gov/standards/status/sub3_4.html |
| FGDC | FGDC-STD-005 | Vegetation Classification Standard | | Supports the use of a consistent national vegetation classification system (NVCS) to produce uniform statistics in vegetation resources from vegetation cover data at the national level. It is important that, as agencies map or inventory vegetated Earth cover, they collect enough data accurately and precisely to translate it for national reporting, aggregation, and comparisons. Adoption of the Vegetation Classification and Information Standards in subsequent development and application of vegetation mapping schemes will facilitate the compilation of regional and national summaries. In turn, the consistent collection of such information will eventually support the detailed, quantitative, geo-referenced basis for vegetation cover modeling, mapping, and analysis at the field level.<br><br>http://www.fgdc.gov/standards/status/sub2_1.html |
| FGDC | FGDC-STD-006 | Soil Geographic Data Standard | | This document proposes a set of data standards for the inventory, mapping, and reporting on the soil resources of the United States. It includes a description of the proposed data elements to be used when reporting and transferring data used to describe soil map units and their components. These map units are associated with soil maps developed by the National Cooperative Soil Survey.<br><br>This document does not detail data elements used to describe soils at a specific point/site on the landscape, the field methods used to collect the data, or the various classification systems used to classify soils. A future standard will likely be developed to deal with point/site data. Documents containing the various classification systems are listed as references at the end of this standard.<br><br>http://www.fgdc.gov/standards/status/sub2_2.html |
| FGDC | FGDC-STD-007 | Geospatial Positioning Accuracy Standard, Part 3, National Standard for Spatial Data Accuracy | | This project only pertains to developing a reporting methodology for the accuracy of point spatial data. It does not involve other standards aspects of point spatial data, e.g., data transfer, data collection, etc.<br><br>http://www.fgdc.gov/standards/status/sub1_1.html |
| FGDC | FGDC-STD-008-1999 | Content Standard for Digital Orthoimagery | | Defines the orthoimage theme of the digital geospatial data framework and envisioned by the FGDC. It is the intent of this standard to set a common baseline that will ensure the widest utility of digital orthoimagery for the user and producer communities through enhanced data sharing and the reduction of redundant data production.<br><br>http://www.fgdc.gov/standards/status/sub3_6.html |

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| FGDC | FGDC-STD-009-1999 | Content Standard for Remote Sensing Swath Data | | The standard defines the minimal content requirements for a remote sensing swath and the relationships among its individual components. It also discusses the treatment of optional supporting information within the swath model. In the classification system of the Federal Geographic Data Committee Standards Reference Model (FGDC 1997), this standard is a Data Content Standard. Data content standards provide semantic definitions of a set of objects and of the relationships among them. This standard defines a concept called a swath that provides a means for associating certain kinds of remote sensing data with their geolocation. To that end, it defines those items of information content that are necessary for the realization of the swath concept. As a content standard, the Content Standard for Remote Sensing Swath Data does not specify encoding. Encoding may be specified at some future time by a separate standard or standards.<br><br>The standard specifies only the information that varies with time or from pixel to pixel. Information that is constant for all data points, such as the axes about which platform roll, pitch, and yaw are measured or the orientation of individual instruments relative to the platform, would be specified elsewhere, for example, in a content standard for remote sensing metadata.<br><br>http://www.fgdc.gov/standards/status/sub4_4.html |
| FGDC | FGDC-STD-010-2000 | Utilities Data Content Standard | | This Utilities Standard supports large-scale, intra-city applications such as engineering and life cycle maintenance of utility systems. The components of each utility system described in this Utilities Standard are considered to represent features located outside the foundation of an enclosed structure. This Utilities Standard describes eleven feature classes: compressed air, electrical distribution, electrical monitoring/control, fuel distribution, heating/cooling systems, industrial waste, natural gas distribution, saltwater, storm drainage collection, wastewater collection, and water distribution. This standard does not contain all features necessary to describe or model communications, alarm systems, or long distance utilities networks that stretch between cities. As with the Spatial Data Transfer Standard (SDTS), this standard uses a logical data model.<br><br>http://www.fgdc.gov/standards/status/sub3_1.html |
| FGDC | FGDC-STD-011-2001 | U.S. National Grid | | This standard defines a preferred U.S. National Grid (USNG) for mapping applications at scales of approximately 1:1,000,000 and larger. It defines how to present Universal Transverse Mercator (UTM) coordinates at various levels of precision. It specifies the use of those coordinates with the grid system defined by the Military Grid Reference System (MGRS). Additionally, it addresses specific presentation issues such as grid spacing. The UTM coordinate representation, the MGRS grid, and the specific grid presentation requirements together define the USNG.<br><br>http://www.fgdc.gov/standards/status/usng.html |

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| ISO | 13249-3:2003 | Information technology -- Database languages -- SQL multimedia and application packages -- Part 3: Spatial | | ISO/IEC 13249-3:2003: introduces the Spatial part of ISO/IEC 13249 (all parts); gives the references necessary for ISO/IEC 13249-3:2003; defines notations and conventions specific to ISO/IEC 13249-3:2003; defines concepts specific to ISO/IEC 13249-3:2003; defines spatial user-defined types and their associated routines.<br>The spatial user-defined types defined in ISO/IEC 13249-3:2003 adhere to the following.<br>* A spatial user-defined type is generic to spatial data handling. It addresses the need to store, manage and retrieve information based on aspects of spatial data such as geometry, location and topology.<br>* A spatial user-defined type does not redefine the database language SQL directly or in combination with another spatial data type.<br>Implementations of ISO/IEC 13249-3:2003 may exist in environments that also support geographic information, decision support, data mining and data warehousing systems.<br>Application areas addressed by implementations of ISO/IEC 13249-3:2003 include, but are not restricted to, automated mapping, desktop mapping, facilities management, geoengineering, graphics, multi-media, and resource management applications.<br>http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=31369 |
| ISO | 17572 | Intelligent Transport Systems (ITS) -- Location Referencing for Geographic Databases | | |
| ISO | 18026 | Information technology -- Spatial Reference Model (SRM) | | |
| ISO | 18042-4 | Information technology -- Computer graphics and image processing -- Spatial reference model language bindings -- Part 4: C | | |
| ISO | 19101:2002 | Geographic Information - Reference Model | | This International Standard defines the framework for standardization in the field of geographic information and sets forth the basic principles by which this standardization takes place.<br>This framework identifies the scope of the standardization activity being undertaken and the context in |

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| | | | | which it takes place. The framework provides the method by which what is to be standardized can be determined and describes how the contents of the standards are related. |
| ISO | 19101-2 | Geographic information -- Reference model -- Part 2: Imagery | | This specification provides a reference model for the open distributed processing of geographic imagery. |
| ISO | 19103 | Geographic information -- Conceptual schema language | | ISO TS 19103:2005 provides rules and guidelines for the use of a conceptual schema language within the ISO geographic information standards. The chosen conceptual schema language is the Unified Modeling Language (UML).<br>ISO TS 19103:2005 provides a profile of UML for use with geographic information. In addition, it provides guidelines on how UML should be used to create standardized geographic information and service models. |
| ISO | 19104 | Geographic information -- Terminology | | This technical specification provides the guidelines for collection and maintenance of terminology in the field of geographic information. It establishes criteria for selection of concepts to be included in other standards concerning geographic information. |
| ISO | 19105:2000 | Geographic Information - Conformance and testing | | No abstract available from ISO. |
| ISO | 19106:2004 | Geographic Information - Profiles | | ISO 19106:2004 is intended to define the concept of a profile of the ISO geographic information standards developed by ISO/TC 211 and to provide guidance for the creation of such profiles. Only those components of specifications that meet the definition of a profile contained herein can be established and managed through the mechanisms described in this International Standard. These profiles can be standardized internationally using the ISO standardization process. This document also provides guidance for establishing, managing, and standardizing at the national level (or in some other forum). |
| ISO | 19107:2003 | Geographic Information - Spatial schema | | ISO 19107:2003 specifies conceptual schemas for describing the spatial characteristics of geographic features, and a set of spatial operations consistent with these schemas. It treats vector geometry and topology up to three dimensions. It defines standard spatial operations for use in access, query, management, processing, and data exchange of geographic information for spatial (geometric and topological) objects of up to three topological dimensions embedded in coordinate spaces of up to three axes. |
| ISO | 19108:2002 | Geographic Information - Temporal Schema | | ISO 19108:2002 defines concepts for describing temporal characteristics of geographic information. It depends upon existing information technology standards for the interchange of temporal information. It provides a basis for defining temporal feature attributes, feature operations, and feature associations, and |

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| | | | | for defining the temporal aspects of metadata about geographic information. Since this International Standard is concerned with the temporal characteristics of geographic information as they are abstracted from the real world, it emphasizes valid time rather than transaction time. |
| ISO | 19109:2005 | Geographic Information - Rules for application schema | | ISO 19109:2005(E) defines rules for creating and documenting application schemas, including principles for the definition of features. Its scope includes the following:<br>■ conceptual modeling of features and their properties from a universe of discourse;<br>■ definition of application schemas;<br>■ use of the conceptual schema language for application schemas;<br>■ transition from the concepts in the conceptual model to the data types in the application schema;<br>■ integration of standardized schemas from other ISO geographic information standards with the application schema. |
| ISO | 19110:2005 | Geographic Information - Methodology for feature cataloguing | | ISO 19110:2005 defines the methodology for cataloguing feature types and specifies how the classification of feature types is organized into a feature catalogue and presented to the users of a set of geographic data. ISO 19110:2005 is applicable to creating catalogues of feature types in previously uncatalogued domains and to revising existing feature catalogues to comply with standard practice. ISO 19110:2005 applies to the cataloguing of feature types that are represented in digital form. Its principles can be extended to the cataloguing of other forms of geographic data. |
| ISO | 19111:2003 | Geographic Information - Spatial referencing by coordinates | | ISO 19111:2003 defines the conceptual schema for the description of spatial referencing by coordinates. It describes the minimum data required to define one-, two- and three-dimensional coordinate reference systems. It allows additional descriptive information to be provided. It also describes the information required to change coordinate values from one coordinate reference system to another. |
| ISO | 19112:2003 | Geographic Information - Spatial referencing by geographic identifiers | | ISO 19912:2003 defines the conceptual schema for spatial references based on geographic identifiers. It establishes a general model for spatial referencing using geographic identifiers defines the components of a spatial reference system and defines the essential components of a gazetteer. Spatial referencing by coordinates is not addressed in this document; however, a mechanism for recording complementary coordinate references is included. |
| ISO | 19113:2002 | Geographic Information - Quality Principles | | ISO 19113:2002 establishes the principles for describing the quality of geographic data and specifies components for reporting quality information. It also provides an approach to organizing information about data quality. |

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| ISO | 19114:2003 | Geographic Information - Quality evaluation procedures | | ISO 19114:2003 provides a framework of procedures for determining and evaluating quality that is applicable to digital geographic datasets, consistent with the data quality principles defined in ISO 19113. It also establishes a framework for evaluating and reporting data quality results, either as part of data quality metadata only, or also as a quality evaluation report. |
| ISO | 19115:2003 | Geographic Information - Metadata | | ISO 19115:2003 defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data. ISO 19115:2003 is applicable to:<br>▪ the cataloguing of datasets, clearinghouse activities, and the full description of datasets;<br>▪ geographic datasets, dataset series, and individual geographic features and feature properties. |
| ISO | 19115-2 | Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data | | ISO 19115-2 defines metadata elements to support imagery, and gridded data and will extend the UML model for metadata to include the following:<br>▪ It will support the collection and processing of natural and synthetic imagery produced by remote sensing and other imaging processes.<br>▪ It will support the collection and processing of geospatial metadata for imagery, gridded and coverage data.<br>▪ It will define a data model for information describing geographic imagery and gridded data, establishing the names, definitions, and permissible values for new data elements including new classes relevant to imagery and gridded data. |
| ISO | 19116-:2004 | Geographic Information - Positioning services | | ISO 19116:2004 specifies the data structure and content of an interface that permits communication between position-providing device(s) and position-using device(s) so that the position-using device(s) can obtain and unambiguously interpret position information and determine whether the results meet the requirements of the use. A standardized interface of geographic information with position allows the integration of positional information from a variety of positioning technologies into a variety of geographic information applications, such as surveying, navigation and intelligent transportation systems. ISO 19116:2004 will benefit a wide range of applications for which positional information is important. |
| ISO | 19117-:2005 | Geographic Information - Portrayal | | ISO 19117:2005 defines a schema describing the portrayal of geographic information in a form understandable by humans. It includes the methodology for describing symbols and mapping of the schema to an application schema. It does not include standardization of cartographic symbols, and their geometric and functional description. |
| ISO | 19118 | Geographic | | This standard specifies methods of encoding for geographic information. |

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| | | Information - Encoding | | |
| ISO | 19119:2005 | Geographic Information - Services | | ISO 19119:2005 identifies and defines the architecture patterns for service interfaces used for geographic information, defines its relationship to the Open Systems Environment model, and presents geographic services taxonomy and a list of example geographic services placed in the services taxonomy. It also prescribes how to create a platform-neutral service specification, how to derive conformant platform-specific service specifications, and provides guidelines for the selection and specification of geographic services from both platform-neutral and platform-specific perspectives. |
| ISO | 19120:2001 | Geographic information -- Functional standards | | |
| ISO | 19121:2000 | Geographic information -- Imagery and gridded data | | ISO 19121-2000 provides a technical report describing imagery and gridded geographic data. |
| ISO | 19123 | Geographic Information - Schema for coverage geometry and functions | | Definition of a standard conceptual schema for describing the spatial characteristics of coverages. |
| ISO | 19125-1:2005 | Geographic Information - Simple feature access -- Part 1: Common architecture | | Identical to OpenGIS ® Simple Features Implementation Specification |
| ISO | 19125-2:2004 | Geographic Information - Simple feature access -- Part 2: SQL option | | Identical to OpenGIS ® Simple Features Implementation Specification |
| ISO | 19127:2005 | Geographic information -- Geodetic codes and parameters | | A Technical Specification on geodetic codes and parameters that defines rules for the population of tables of geodetic codes and parameters and identifies the data elements required within these tables, in compliance with ISO 19111, Geographic information |
| ISO | 19128 | Geographic information -- Web Map Server interface | | Identical to OpenGIS ® Web Map Service Implementation Specification v 1.3 |

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| ISO | 19129 | ISO 19129 - Geographic information - Imagery, gridded and coverage data framework | | A Technical Specification defining the framework for imagery, gridded and coverage data and those elements that require standardization that are not identified in other ISO 19100 standards. |
| ISO | 19130 | Geographic information -- Sensor and data models for imagery and gridded data | | The purpose of this standard is to generate a generic sensor and data model. |
| ISO | 19131 | Geographic information -- Data product specification | | The purpose of this is to provide practical help in the creation of data product specifications in conformance with other existing standards for geographic information. |
| ISO | 19132 | Geographic information -- Reference model -- Location based services framework | | This international standard establishes a framework supporting the development of location-based services (LBS). LBS are software services whose request and response pattern or values depend upon the location of some number of things, either real or conceptual. |
| ISO | 19133 | Geographic information -- Location-based services -- Tracking and navigation | | This International Standard will specify 'web' based services in support of (mobile) clients |
| ISO | 19134 | Geographic information -- Location based services -- Multimodal routing and navigation | | This International Standard will specify: Route finding or navigation between two targets using two or more modes of transportation. |
| ISO | 19135 | Geographic information -- Procedures for registration of geographical information items | | Specifies procedures to be followed in preparing, maintaining, and publishing a register or registers of unique unambiguous and permanent identifiers, and meanings that, under the direction of ISO/TC 211, are assigned to geographic information items. |

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| ISO | 19136 | Geographic information -- Geography Markup Language | | This IS defines modeling language based on XML that extends it to allow definition and encoding of geographic data of all types. |
| ISO | 19137 | Geographic information -- Generally used profiles of the spatial schema and of similar important other schemas | | This TS provides a set of profiles of the spatial schema to provide a minimum set of geometric elements necessary for an efficient creation of application schemata. |
| ISO | 19138 | Geographic information -- Data quality measures | | ISO 19113 Geographic information - Quality principles establishes the principles for the description of geographic data quality and specifies components for reporting quality information. Procedures for the evaluation of geographic data quality are described in ISO 19114 Geographic information - Quality evaluation procedures. |
| ISO | 19139 | Geographic information -- Metadata -- XML schema implementation | | Technical specification defining a UML implementation model that is based on the ISO 19115 abstract UML model. |
| ISO | 19141 | Geographic information -- Schema for moving features | | This work item extends IS19108 Temporal features to address the concept of features that move over time. |
| ISO | 19142 | Geographic Information - Web Feature Service | | Identical to OpenGIS ® Web Feature Service Implementation specification. |
| ISO | 19143 | Geographic Information - Filter encoding | | Identical to OpenGIS ® Filter Encoding Implementation Specification |
| ISO | 6709:1983 | Standard representation of latitude, longitude and altitude for geographic point | | Describes a variable-length format for the representation of latitude, longitude and altitude for use in data interchange. Allows the use of normal sexagesimal notations involving degrees, minutes and seconds as well as various combinations of sexagesimal and decimal notations. Uses numeric characters 0 to 9, graphic characters plus (+), minus (-), full stop (.) and comma (,). |

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| ANSI | 320-1998 (R2003) | Information technology - Spatial Data Transfer | | Data content and encoding standard to be used by U.S. Federal Government offices. |
| ANSI | 353-2004 | Information Technology - Geographical Information Systems - Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) | | Profile of SDTS for facilities management |
| ANSI | 61-1986 (R2002) | Geographic Point Locations for Information Interchange, Representation of (formerly ANSI X3.61-1986 (R1997)) | | Encoding of geographic point location information. |
| INCITS | BSR INCITS PN-1574-D-200x | Information technology - Geographic Information Framework Data Content Standards | | |
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| OASIS | CAP | Common Alerting Protocol v 1.0 | | http://www.oasis-open.org/committees/download.php/6334/oasis-200402-cap-core-1.0.pdf |
| n/a | GeoTIFF | GeoTIFF | 1.8.2 | The GeoTIFF specification defines a set of TIFF tags provided to describe all "Cartographic" information associated with TIFF imagery. Its aim is to allow means for tying a raster image to a known model space or map projection, and for describing those projections.<br>http://www.remotesensing.org/geotiff/geotiff.html |

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| DoD | | USIGS Glossary | | Intelligence community feature and attribute glossary |
| DoD | | DMA TM 8358.1 | | Datums Ellipsoids, Grids and Grid Reference Systems, Technical Manual, 20 September 1990. (includes index of preferred datums) |
| DoD | | DMA TM 8358.2 | | DoD World Geodetic Systems 1984, Its Definition and Relationship to Local Geodetic Systems, 3rd Edition Amendment 1, Technical Report 3, January 2000 |
| DoD | | NIMA TR 8350.2 | | DoD World Geodetic Systems 1984, Its Definition and Relationship to Local Geodetic Systems, 3rd Edition Amendment 1, Technical Report 3, January 2000 |
| | | GPS-CI-222A | | NAVSTAR GPS UE Auxiliary Output Chip Interface (U), 26 April 1996. |
| | | GPS-DR-225A | | NAVSTAR GPS UE Auxiliary Output Chip Interface (U), 26 April 1996. |
| | | GPS-UI-200C-1 | | NAVSTAR GPS UE Auxiliary Output Chip Interface (U), 26 April 1996. |
| | | GPS-SS-001A | | NAVSTAR GPS Selective Availability Anti-Spoofing Module System Specification, 27 September 1999. |
| DoD | | MIL-STD-2401 | | NAVSTAR GPS Selective Availability Anti-Spoofing Module System Specification, 27 September 1999. |
| DoD | | MIL-STD-600001 | | NAVSTAR GPS Selective Availability Anti-Spoofing Module System Specification, 27 September 1999. |
| DoD | | DGIWG Feature Data Dictionary (DFDD) | | NAVSTAR GPS Selective Availability Anti-Spoofing Module System Specification, 27 September 1999. |
| ISO | | ISO 19110 - Geographic information - Methodology for feature cataloguing | | ISO 19110:2005 defines the methodology for cataloguing feature types and specifies how the classification of feature types is organized into a feature catalogue and presented to the users of a set of geographic data. ISO 19110:2005 is applicable to creating catalogues of feature types in previously uncatalogued domains and to revising existing feature catalogues to comply with standard practice. ISO 19110:2005 applies to the cataloguing of feature types that are represented in digital form. Its principles can be extended to the cataloguing of other forms of geographic data. |

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| ISO | | ISO 19126 - Geographic information - Profile - FACC Data Dictionary | | This International Standard is a profile. It is based on rules and methods defined in ISO CD 19110 (15046-10) Geographic information - Feature cataloguing methodology, in the context of DGIWG. It defines a Data Dictionary and includes the definition of Fe |
| DoD | | FIPS Pub 10-4:2002 | | Countries, Dependencies, Areas of Special Sovereignty, and Their Principal Administrative Divisions, April 1995 as modified by Change Notice 1, 1 Dec 1998; Change Notice 2, 1 Mar 1999; Change Notice 3, 1 May 1999; Change Notice 4, 25 Feb 2000; Change Notice 5, 10 Aug 2000; Change Notice 6, 28 Jan 2001; and Change Notice 7, 10 Jan 2002. |
| DoD | | MIL-STD-2407:1999 | | Interface Standard for Vector Product Format (VPF), 28 June 1996, with Notice of Change, Notice 1, 26 October 1999. |
| ISO | | ISO 19118 - Geographic information - Encoding | | Selection of encoding rules compatible with the conceptual schemata that apply to geographic information and definition of the mapping between the conceptual schema language and the encoding rules. |
| ISO | | ISO 19131 - Geographic information - Data product specifications | | This International Standard will provide requirements for the specification of geographic data products. These will include the application schema, spatial and temporal referencing systems, quality and data capture and maintenance processes. |
| DoD | | MIL-PRF- 0089049, Vector Product Format Products General Specification | | General Performance Specification Vector Product Format (VPF) Products, 24 Nov 1998 |
| DoD | | Unified Profile - Mission Specific Data (UP-MSD) | | MSD provides the required geospatial detail (at the needed density/resolution and accuracy) and feature and/or attributes to meet specialized mission needs. The unified profile for MSD has five levels of granularity that increase in feature count (the number of possible feature types) as the data resolution increases. |
| DoD | | MIL-PRF-89039 | | Vector Map (VMAP) Level 0, 9 Feb 1995 with Amendment 2 dated 28 Sep 1999 for overview display |
| DoD | | MIL-PRF- 89033 | | Vector Map (VMAP) Level 1 Amend 1 01 Jun 95/27 May 98 |
| DoD | | MIL-PRF 89049/1 | | Associated Performance Specification for Foundation Feature Data (FDD), 30 Nov 1998 |

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| DoD | | MIL-PRF-89023 | | Performance Specification for Digital Nautical Chart (DNC), Amendment 1, 19 December 1997, 23 Feb 1999 |
| DoD | | MIL-PRF-89035A | | Urban vector Map (UVMAP), 1 Aug 2002 |
| DoD | | MIL-PRF-89037A | | Digital Topographic Data (DTOP) 01 Aug 02 |
| DoD | | MIL-PRF-89049/9, Vector Vertical Obstruction Data (VVOD) | | VVOD is a vector-based digital product that portrays VVOD. The DB contains all man-made obstructions on the earth's surface which are sufficiently tall so as to pose a hazard to powered flight, both manned and unmanned. 24 May 2004 |
| DoD | | MIL-PRF-89040A | | Vector Product Interim Terrain Data, 8-May-96, Amendment 2 01-Aug-02 |
| DoD | | MIL-STD-2411(2) | | Raster Product Format, 6 October 1994; with Notice of Change, Notice 1, 17 January 1995, and Notice of Change, Notice 2, 16 August 2001. |
| DoD | | MIL-PRF-89020B | | Performance Specification for Digital Terrain Elevation Data (DTED) |
| DoD | | MIL-PRF-89034 | | Digital Point Positioning Data Base (DPPDB) |
| | | FM 92-X Ext. GRIB WMO No. 306 | | FM 92-X Ext. GRIB WMO No. 306 |
| DoD | | MIL-PRF-89041 A | | Controlled Image Base (CIB) Amend 1 |
| DoD | | MIL-PRF-89038 | | MIL-PRF-89038 06-Oct-94 |
| | | SRTM | | Shuttle Radar Topography Mission Ground Data Processing System Data Product Specification |
| DoD | GeoSym | MIL-DTL-89045, Geospatial Symbology for Digital Display | | Geospatial Symbology for Digital Display -- includes FACC |
| DoD | | MIL-STD-2525B | | Common Warfighting Symbology |

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| NGA | | N101-G | | Geospatial and Imagery Access Services Specification (GIAS) v3.5.1 6 Aug 2001 with CN 8 May 2002 |
| NGA | | N102-G | | USIGS Interoperability Profile (UIP) 26 Jun 20001 with CN through 1 Oct 2003 |
| NGA | | N104-G | | (UCOS) USIGS Common Object Specification, v 1.5.1 with CN through 8 May 2002 |

2999 # Appendix I: Acronym List

| Acronym | Definition |
|---|---|
| ADA | Americans with Disabilities Act of 1990 |
| ADT | Abstract Data Type |
| AIC | Architecture and Infrastructure Committee, Federal CIO Council |
| ANSI | American National Standards Institute |
| AOI | Area of Interest |
| API | Application Programming Interface |
| AVL | Automatic Vehicle Locator |
| BASINS | Better Assessment Science Integrating Point and Non-point Sources |
| BC | Business Component |
| BCS | Business Component System |
| BNF | Backus Naur Form |
| BRM | Business Reference Model |
| CADD | Computer-Aided Design and Drafting |
| CAT | OpenGIS Catalogue Service |
| CATS | Consequences Assessment Tool Set |
| CIO | Chief Information Officer |
| COI | Community of Interest |
| COM | Component Object Model (see OLE) |
| COP | Common Operating Picture |
| CORBA | Common Object Request Broker Architecture |
| COTS | Commercial Off The Shelf |
| CQL | Collection Query Language |
| CSDGM | Content Standard for Digital Geospatial Metadata |
| CSW | OpenGIS Catalogue Service for the Web |
| CT | OpenGIS Coordinate Transformation Service |
| CWA | Clean Water Act |
| DBMS | Database Management System |
| DC | Distributed Component |
| DEM | Digital Elevation Model |

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|---|---|
| DFIRM | Digital Flood Insurance Rate Map |
| DFO | Disaster Field Office |
| DHS | Department of Homeland Security |
| DISN | Defense Information Systems Network |
| DRM | Data Reference Model |
| DTM | Digital Terrain Model |
| EA | Enterprise Architecture |
| EAAF | Enterprise Architecture Assessment Framework |
| ESRI | Environmental Systems Research Institute |
| FAA | Federal Aviation Administration |
| FEA | Federal Enterprise Architecture |
| FEAPMO | Federal Enterprise Architecture Program Management Office |
| FGDC | Federal Geographic Data Committee |
| FOUO | For Official Use Only |
| GDR | Geospatial Data Rollup |
| GEA COP WG | Geospatial Enterprise Architecture Community of Practice Working Group |
| GIF | Graphics Interchange Format |
| GIMM | Geospatial Integration Maturity Model |
| GIO | Geographic Information Officer |
| GIRM | Geospatial Interoperability Reference Model |
| GIS | Geographic Information System |
| GIT | Geospatial Information Technology |
| GML | Geography Markup Language |
| GMO | Geospatial Management Office |
| GOS | Geospatial One-Stop |
| GPS | Global Positioning System |
| GSA | General Services Administration |
| HEC2 | Hydrologic Engineering Center 2 |
| HSIN | Homeland Security Information Network |
| HVAC | Heating, Ventilation & Air Conditioning |
| ICS | Image Catalog Service |
| INS | Inertial Navigation System |
| InSAR | Interferometric Synthetic Aperture Radar |

| | |
|---|---|
| INCITS | InterNational Committee for Information Technology Standards |
| IPS | Image Processing System |
| ISO | International Standards Organization |
| ISO/TC 211 | ISO Technical Committee 211 (Geographic Information/Geomatics) |
| IT | Information Technology |
| ITS | Intelligent Transport System |
| JPEG | Joint Photographic Expert Group |
| LBS | Location-Based Service |
| LiDAR | Light Detection and Ranging |
| LOB | Line of Business |
| LOF | Location Organizer Folder |
| LORAN | Long Range Radio Aid to Navigation |
| MOA | Memorandum of Agreement |
| MOU | Memorandum of Understanding |
| MSOP | Mission-Specific Operating Picture |
| NASA | National Aeronautics and Space Administration |
| NEPA | National Environmental Policy Act |
| NFIP | National Flood Insurance Program |
| NGA | National Geospatial-Intelligence Agency |
| NGPO | National Geospatial Programs Office |
| NIEM | National Information Exchange Model |
| NOAA | National Oceanic & Atmospheric Administration |
| NOV | Notice of Violation |
| NSDI | National Spatial Data Infrastructure |
| NSGIC | National States Geographic Information Council |
| NSRS | National Spatial Reference System |
| NVCS | National Vegetation Classification System |
| OASIS | Organization for the Advancement of Structured Information Standards |
| OGC | Open GIS Consortium |
| OLE | Object Linking and Embedding (see COM) |
| OMB | Office of Management and Budget |
| ORM | OpenGIS Reference Model |

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|---|---|
| OSHA | Occupational Safety and Health Act of 1970 |
| OWS | OpenGIS Web Services |
| PDA | Personal Digital Assistant |
| PDD | Presidential Decision Directive |
| PMO | Program Management Office |
| PNG | Portable Network Graphics |
| PNT | Positioning Navigation Targeting |
| POC | Point of Contact |
| POI | Point of Interest |
| PRM | Performance Reference Model |
| RFID | Radio Frequency Identification Device |
| ROI | Return on Investment |
| SAR | Synthetic Aperture Radar |
| SBP | Semantic Business Profiles |
| SBU | Sensitive But Unclassified |
| SCADA | Supervisory Control and Data Acquisition |
| SDP | Semantic Data Profiles |
| SDTS | Spatial Data Transfer Standard |
| SLA | Service Level Agreement |
| SLD | Styled Layer Descriptor |
| SMS | Style Management Service |
| SOA | Service Oriented Architecture |
| SQL | Structured Query Language |
| SRM | Service Component Reference Model |
| SSP | Semantic Service Profiles |
| TIFF | Tagged Image File Format |
| TNM | The National Map |
| TRM | Technology Reference Model |
| UML | Unified Modeling Language |
| URI | Uniform Resource Identifier |
| URISA | Urban and Regional Information Systems Association |
| USGS | US Coast Guard |
| USGS | U.S. Geological Survey |
| USOP | User-Specific Operating Picture |

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|---|---|
| WCS | Web Coverage Service |
| WFS | Web Feature Service |
| WGS | World Geodetic System |
| WMS | Web Map Service |
| WRS | Web Registry Service |
| WSDL | Web Services Definition Language |
| WTS | Web Terrain Server |
| XIMA | Image and Map Annotation |
| XML | Extensible Markup Language |

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