DRAFT

Federal Enterprise Architecture
Geospatial Profile
Version 0.2

DOCUMENT STATUS:

This is a draft document provided as an interim deliverable.

The primary difference between versions 0.2 and 0.1 is that the comments received in the review of version 0.1 have been resolved and the resolutions have been incorporated into this version 0.2.

Work is already underway on a version 0.3 that will contain the result of processing the items in the TODO list provided on page 6 of this document (and other items that arise during that process).

Comments on version 0.2 will be welcomed if sent by October 21, 2005 to geo-forum@colab.cim3.net. Please use the comment form provided at http://colab.cim3.net/cgi-bin/wiki.pl?CurrentGeospatialProfileDraft and refer to line numbers in the PDF version of this document.

Version 0.3 will be provided on October 28, 2005.

Architecture and Infrastructure Committee,

Federal Chief Information Officers Council

And

Federal Geographic Data Committee

October 7, 2005

25 # Executive Summary

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Acknowledgements

To Be Provided.

TODO List

The following is a list of tasks to do that is provided to limit comments on areas where further work is already planned/identified. This should not, however, limit substantive suggestions about how to complete the items on this list including candidate completions by the commenting individuals.

1. Consider further reordering within section 1. (Doug/Editor)

2. Further describe the NSDI diagram (once it has been finalized) and consider another diagram to present the organization elements of the NSDI. (Editor)

3. Further refine/edit the scenario (Appendix C) and consider a) expansion of or b) removal of the overview of the scenario in Chapter 1. (Editor/Raj) There is a place holder in section 1.7.

4. Complete/Edit the use case example for the DRM. Further refine the examples for BRM, SRM, and TRM. (Editor/Raj)

5. Edit Chapter 2 further to make the geospatial view sections a bit more consistent in their presentation. (Editor and others TBD)

6. Insert description of and linkages to online locations for (what we hope will be) volatile artifacts (service components, standards, business language, others?). Describe the update process for these. (Editor/Doug/Brenda)

7. Provide descriptions where noted in the Geospatial TRM section. (Raj/Editor)

8. 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 E). (Raj/Editor). This might slip beyond version 0.3 depending on the time required.

9. Provide an Executive Summary (Editor)

10. Provide the Acknowledgements (Editor/Doug/Brenda)

11. Identify and provide glossary items for words in the body of the text (has been dome for the Geospatial SRM up to this point). (Editor)

12. Identify and provide acronyms for the acronym list (completed for the Geospatial Business Language appendix) (Editor)

13. Provide a complete consistency check on acronyms, glossary items, etc. (Editor)

1 Introduction

Geospatial data and capabilities are integral to virtually all federal, state, local, and tribal government activities. The purpose of this Federal Enterprise Architecture (FEA) Geospatial Profile is to provide guidance to government organizations to help them identify and describe the geospatial data, capabilities, and needs within their enterprise architecture. These capabilities and needs will then be reflected in their Information Technology infrastructure and become part of the business processes that are essential for mission fulfillment. The profile supports the development and use of common and shared geospatial resources within the National Spatial Data Infrastructure (NSDI, described in Section 1.5).

The Geospatial Profile is an integral part of the Federal Enterprise Architecture program managed by the Office of Management and Budget (OMB). The purpose of the FEA is to coordinate the various activities of individual government agencies towards an overall integrated and interoperable Federal Enterprise Architecture.

In addition, it is intended to provide guidance to the very broad community of state, local, tribal, and private sector organizations that have data and assets that must be readily integrated and shared with Federal organizations.

The Geospatial Profile is designed to encourage the development and implementation of enterprise architectures that integrate the discovery, access, integration, fusion, and application of geospatial data and services. Collaborative organizational enterprise architecture is vital to improved government mission and business performance and decision-making. The profile also promotes the adoption and use of interoperable, standards-based geospatial tools and technologies.

The Geospatial Profile intends to foster the implementation of a consistent approach for incorporating geospatial data and technologies into all government architectures that comprise the FEA. Applying the Geospatial Profile will help government organizations produce architectures that will enable them to more effectively contribute to, and benefit from, the National Spatial Data Infrastructure.

> *When completed, the Geospatial Profile is intended to be endorsed by the Office of Management and Budget and its FEA Program Management Office as an integral part of the FEA.*

1.1 Objectives

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

1) Provide guidance for documenting and integrating geospatial capabilities within each of the FEA reference models (Performance, Business, Service Component, Data, and Technical)

2) Demonstrate how geospatial capabilities are related across the reference models

3) Describe how geospatial capabilities apply across business lines and agencies

4) Provide examples of applying the Geospatial Profile's guidance by using a mission-oriented use case

5) Discuss how geospatial capabilities may interact with other FEA profiles that are under development

6) Provide guidance to architects to help identify and exploit geospatial technologies

7) Initiate the establishment of a knowledge base for those applying the Geospatial Profile to their enterprise architecture efforts by providing initial geospatial artifacts[1].

1.2 Audience

The Geospatial Profile is intended to inform a range of audiences, ***not*** just architects and geospatial technology professionals. The profile should be useful to the following:

- ***Business Managers and Sponsors***: those responsible for defining mission and business line needs that rely on geospatial capabilities.
- ***CIO Office Leadership and Staff***: those responsible for the overall coordination of an organization's IT planning, development, and management activities to support business needs.
- ***Geospatial Information Officers (GIOs)***: those responsible for planning and managing an organization's geospatial activities, investments, and assets.
- ***Architects***: those responsible for developing enterprise architectures and managing enterprise architecture programs, and ensuring that geospatial requirements are incorporated within enterprise architectures.
- ***Discipline Practitioners***: organizations and individuals responsible for ensuring that architectures, planned investments, and implementations adequately address needs from the perspective of individual disciplines. Examples of disciplines include: data management, information security, privacy, records management, geospatial, human capital management, and others.
- ***Portfolio Managers and Capital Planners***: those responsible for planning, budgeting, and justifying portfolios of investment initiatives.
- ***Solutions Providers and Integrators:*** those organizations providing products and services for delivering integrated solutions to meet or support mission and business line needs
- ***Geospatial Vendors and Consultants***: those offering geospatial products and services that may enable the implementation of geospatial capabilities (described in an enterprise architecture) to support mission and business needs.

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 section 2.2 for more information on this topic).

[1] For example, the geospatial business language (see Geospatial BRM in section 2.3), geospatial service components (see Geospatial SRM in section 2.5), geospatial data (see Geospatial DRM in section 2.4) and technology standards (see Geospatial TRM in section 2.6), and a geospatial integration maturity model (see Geospatial PRM in section 2.7).

1.3 Geospatial Information Is Everywhere

The value of geospatial information is obvious to many people when it is in the form of a map or satellite image. The presence and value of geospatial data is not as obvious when it is embedded within text, statistics, charts, records or other information in a database.

In many cases locations within databases exist as postal addresses. However, geospatial data is any type of data that can be associated with a location in space and time. So in addition to a postal address it can be a place name; the position of a vehicle with a GPS receiver; 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 something to a location.

Geospatial services and technologies are software and hardware functions and capabilities which provide for the collection, access, analysis, dissemination, integration, sharing and use of geospatial information. In its fullest sense, geospatial information is ubiquitous and cuts across all lines of business in a multitude of applications. Geospatial information systems have tremendous potential to integrate information from seemingly disconnected activities and a variety of sources.

1.4 Challenges To Be Addressed

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)[2]:

> *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 following challenges impact the effective 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
- Interoperability among providers and consumers of geospatial data and services requires a shared understanding of semantics and functional capabilities
- 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 often do not use the best 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
- Geographic information and services are not planned, acquired, managed, and shared consistently within and across organizations

[2] http://www.whitehouse.gov/omb/egov/fy03_egov_rpt_to_congress.pdf

- Geospatial data and services are not readily made available to users and applications through a web browser or service-oriented architecture

1.5 The National Spatial Data Infrastructure

The National Spatial Data Infrastructure was established by the Federal government in partnership with state and local organizations to increase and improve the availability to use geospatial information across all sectors within the United States. The NSDI is described in OMB Circular A-16 as "the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data." The NSDI and the associated Geospatial-One Stop Portal and The National Map can be used to support the business of agencies and organizations in and out of the Federal Enterprise by:

1) Providing access to geospatial data and services for all lines of business

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

3) Facilitating the sharing and reuse of data and services through standards and specifications for interoperability

4) Providing a user-oriented delivery system which enables multiple means of delivery

5) Ensuring that redundancy and waste are reduced to a minimum and that data and services meet users needs and are easy to use

Government organizations benefit from having NSDI adopted practices and standards espoused in the profile and promoted through groups like the FGDC, National States Geographic Information Council (NSGIC), National Association of Counties (NACO), National Association of State Chief Information Officers (NASCIO) and others who all have an interest in people and systems working well together.

Figure 1 shows the key components of the NSDI.

The Geospatial One-Stop initiative provides discovery and visualization services of national geographic data and other services through its portal at geodata.gov. The adoption of Geospatial Profile practices will increase discovery of and access to available resources of domestic interest.

The National Map is a key set of data layers backed by web mapping and data access services of national scope that are integral elements of the Geospatial Profile guidance. The NSDI is the umbrella activity for all these geospatial efforts that is realized through coordinated efforts by all participants.

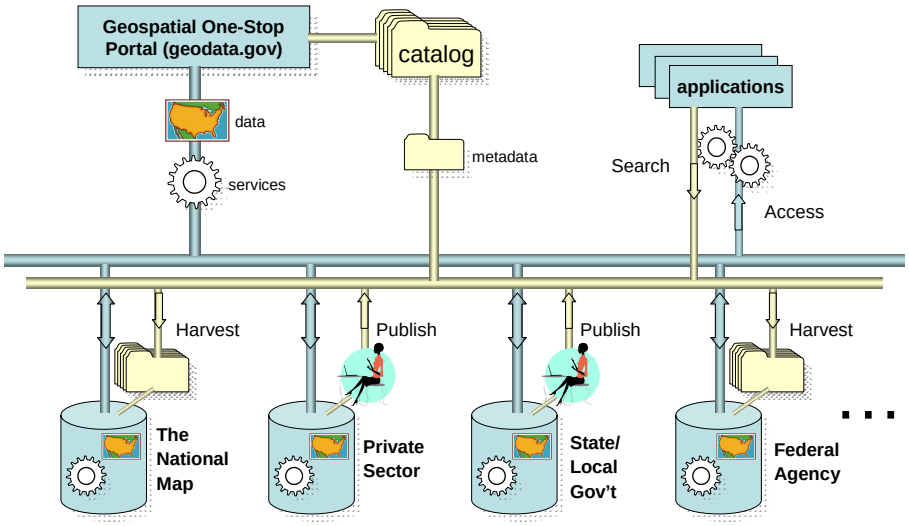

Figure 1: Key components of the National Spatial Data Infrastructure (NSDI)

1.6 Overview of Geospatial Capabilities

This section provides a high-level overview of geospatial information and services.

1.6.1 What is Geospatial Information?

Geospatial information is used in a majority of business settings both inside and outside the government. Geospatial Data includes any type of data that has an associated geographic location or extent used in a business setting, both inside and outside the government. Examples include: building addresses, transportation networks, utility networks, imagery, buildings and facilities, airspaces, and jurisdictional boundaries. Geospatial data may be represented in one or more dimensions, such as a position or extent or region, and may also include dynamics over time, for example the progression of the shape and path of a hurricane (see Figure 2).

Geospatial information includes not only information that is obvious to most people as geographic in nature, such as elevations, satellite imagery, and global positioning system (GPS) position coordinates, but also includes other types of information that many people may not realize have geospatial or locational characteristics. For example:

- Human resources systems capture the office building and room, and home address, 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 other types of data can be enabled by a well-designed architecture and can be used in many different ways to help improve the performance of a government or business organization.

In addition, in operational and support situations, a moving asset or reported or sensed entity or event 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.

Section 2.7 of the Geospatial Profile describes how geospatial data and information should be incorporated into each organization's Enterprise Architecture.

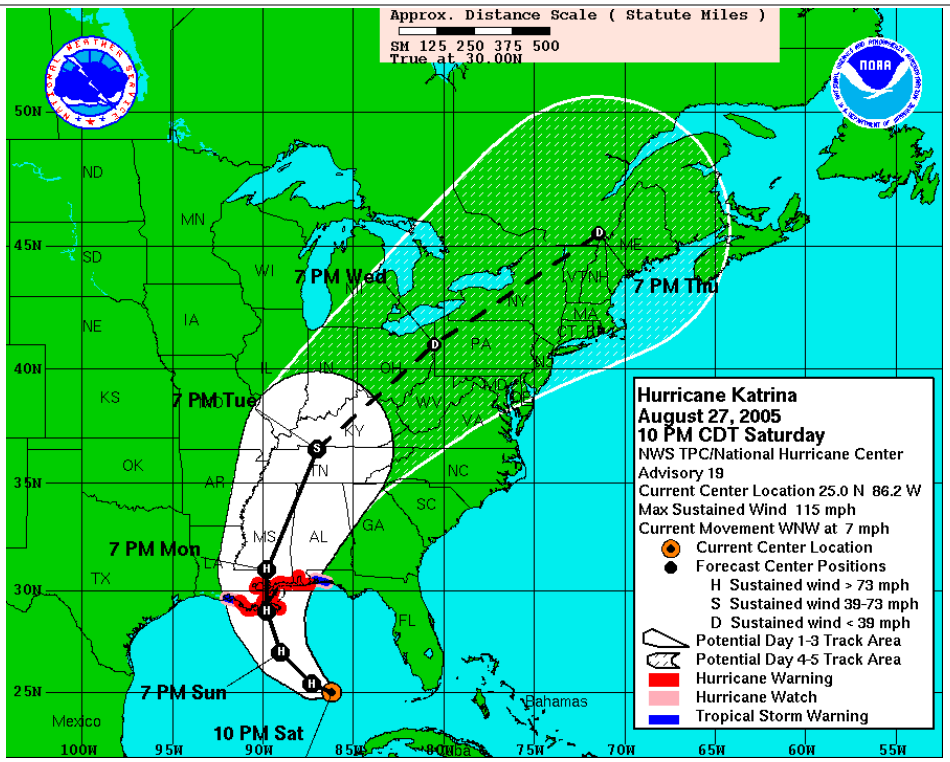

Figure 2:Hurricane Katrina 5-day track warning and uncertainty cone.

1.6.2 How is Geospatial Information Used?

Any information that has an associated location can be subjected to/used for performing geospatial queries, analysis, intelligence, and visualization. Combinations of data sources may be needed to provide users an integrated view over time of events, tracked entities, and their locations to support and coordinate decision-making during operational planning, preparedness, prevention, response, and remediation. Hurricane track forecasting is an example of the use of geospatial information along with geospatial queries, analysis, intelligence, and visualization to support decision-making (see Figure 2).

Sections 2.7 and 2.3 of the Geospatial Profile describe how geospatial capabilities support the business functions (2.3) and performance metrics (2.7) in each organization's Enterprise Architecture.

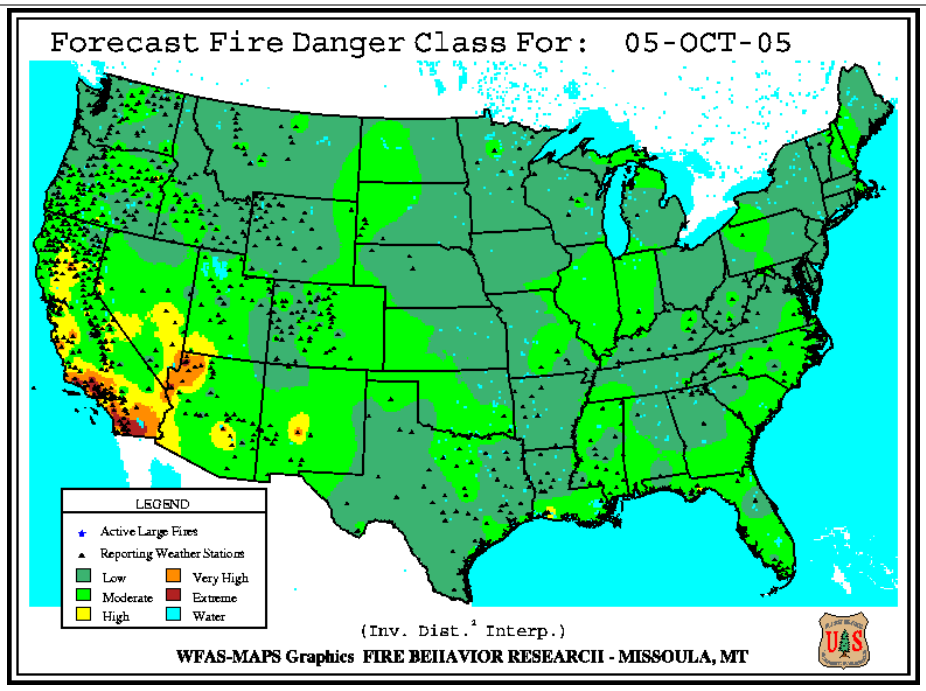

Figure 3: Fire forecast created using geospatial information and analysis

1.6.3 What are Geospatial Services?

Geospatial services are well-defined software functions that access locational data to produce specific results such as visualizations, queries, and analyses. Examples of general-purpose geospatial services that may be used by many business applications include:

- Determining the geographic coordinates corresponding to a person's address
- Identifying routes for navigating from one location to another
- 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 types, attributes, and geographic regions or political boundaries
- Converting geographic data from one reference datum or projection 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.

Section 2.5 of the Geospatial Profile describes how geospatial services should be incorporated into each organization's Enterprise Architecture.

1.7 Use Case Overview

A wildfire use case will be used throughout this document to provide examples of the concepts and processes within this Geospatial Profile, particularly in section 2. The use case details response and recovery to the wildfire event. For further detail on the scenario content, please see Appendix C.

1.8 Federal Policies and Drivers

The OMB FEA Program Management Office's (PMO) 2005 - 2006 Federal Enterprise Architecture Action Plan (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.
>
> OMB has issued guidance (i.e., OMB Circulars A-16 and A-11) 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. […]

Other drivers from Federal law and policy are provided as Appendix H.

1.9 Authority

The Geospatial Profile was developed by the Geospatial Community of Practice under the direction of the Federal Chief Information Officers Council's Architecture and Infrastructure Committee (AIC) and the FGDC, and in coordination with the FEA PMO.

Federal CIO Council, Architecture and Infrastructure Committee—The Architecture and Infrastructure Committee of the Federal Chief Information Officers Council (CIO Council) develops policy, direction, and guidance for the Federal Enterprise Architecture to drive business process improvement, investment management, and technical decisions. These efforts assist with institutionalizing the FEA in concert with agency enterprise architectures.

Federal Geographic Data Committee—The Federal Geographic Data Committee was formed in 1990 by OMB to develop the National Spatial Data Infrastructure in cooperation with organizations from state, local, and tribal governments, the academic community, and the private sector. The NSDI encompasses policies, standards, and procedures for organizations to cooperatively produce, share and use geographic data.

Federal Enterprise Architecture Program Management Office—OMB's Federal Enterprise Architecture Program Management Office (FEA PMO) provides direction, guidance, and requirements to federal agencies for developing and using enterprise architectures and for achieving business-oriented results by implementing enterprise architectures. The FEA PMO also works with the CIO Council to facilitate the advancement of federal architecture practices through communities of interest and knowledge sharing.

Geospatial Enterprise Architecture Community of Practice—The Geospatial Enterprise Architecture Community of Practice (GEA COP or GeoCOP) Working Group was established in 2005 under the auspices of the AIC and the FGDC to serve as the focal point for the advancement of the Geospatial Profile, consistent with the proven practices of the NSDI.

As noted in Section 1.8, the establishment of the FEA Geospatial Profile is one of the action areas identified in the FEA PMO Action Plan of March 2005.

Section 2.1 provides an overview of the FEA reference models.

2 Geospatial Capabilities and the FEA Reference Models

This chapter provides the primary guidance of the Geospatial Profile. It is organized as a set of views on the elements of the Federal Enterprise Architecture and, thus, an overview is provided for the convenience of the reader. A discussion of the relationship of geospatial to each FEA element in turn is then provided; in each case additional background on the FEA elements is given.

2.1 FEA Overview

This overview text is quoted directly from the FY07 Budget Formulation FEA Consolidated Reference Model Document[3].

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 section introduces the purposes and structures of the five FEA reference models:

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

2.1.1 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 4 for the BRM tiered hierarchy.

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

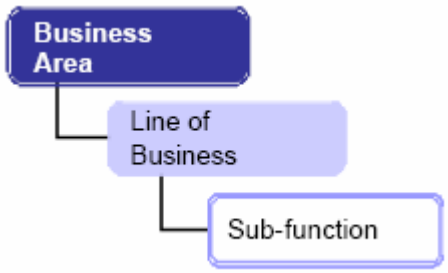

Figure 4: BRM Structure

2.1.2 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 5).

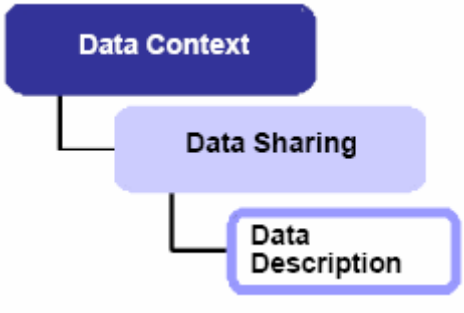

Figure 5: DRM Structure

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 5 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.

2.1.3 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 reuse 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 reuse of applications, application capabilities, components, and business services. It is structured hierarchically as depicted in Figure 6.

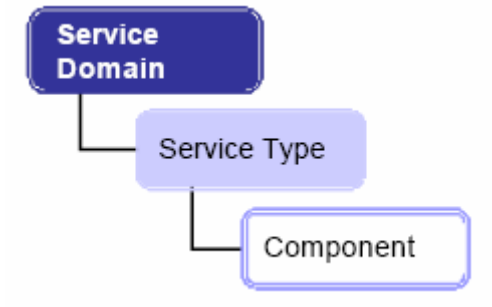

Figure 6: SRM Structure

2.1.4 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 reuse 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 7.

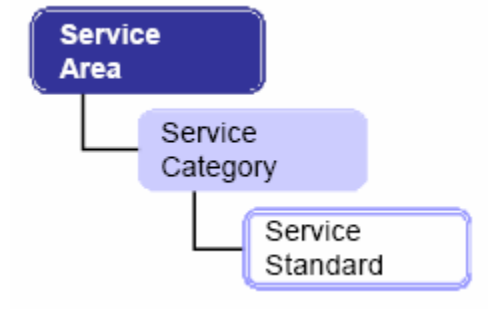

Figure 7: TRM Structure

2.1.5 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 8 for the PRM structure.

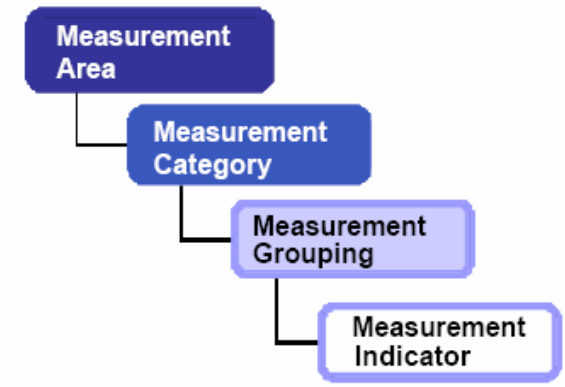

Figure 8: PRM Structure

2.2 How The Geospatial Profile Interacts with 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, section 2.7)—In the geospatial view of the PRM, the discussion focuses on providing enterprise architects with metrics that can be used to measure their geospatial maturity.
- Business Reference Model (BRM, section 2.3)—In the geospatial view of the BRM, the discussion centers around a process and methodology to help enterprise architects identify and describe the geospatial nature of their business activities.
- Service Component Reference Model (SRM, section 2.5)—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 as well as some guidance and background to help enterprise architects deal with issues of granularity and other difficult concepts.
- Technical Reference Model (TRM, section 2.6)— 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.
- Data Reference Model (DRM, section 2.4)— 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.

2.3 Geospatial View of the Business Reference Model (Geospatial BRM)

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.

This section includes: a) a background and purpose of the FEA BRM and an explanation of the geospatial aspects of its elements, b) the relationship of the National Spatial Data Infrastructure (NSDI) to the BRM and c) a process that supports including geospatial components into the enterprise architecture of an organization.

2.3.1 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) independently of the agencies that perform them and categorizes them into 3 Business Areas. These three business areas are: Service for Citizens, Support Delivery of Services, and Management of Government Resources (see Figure 9).

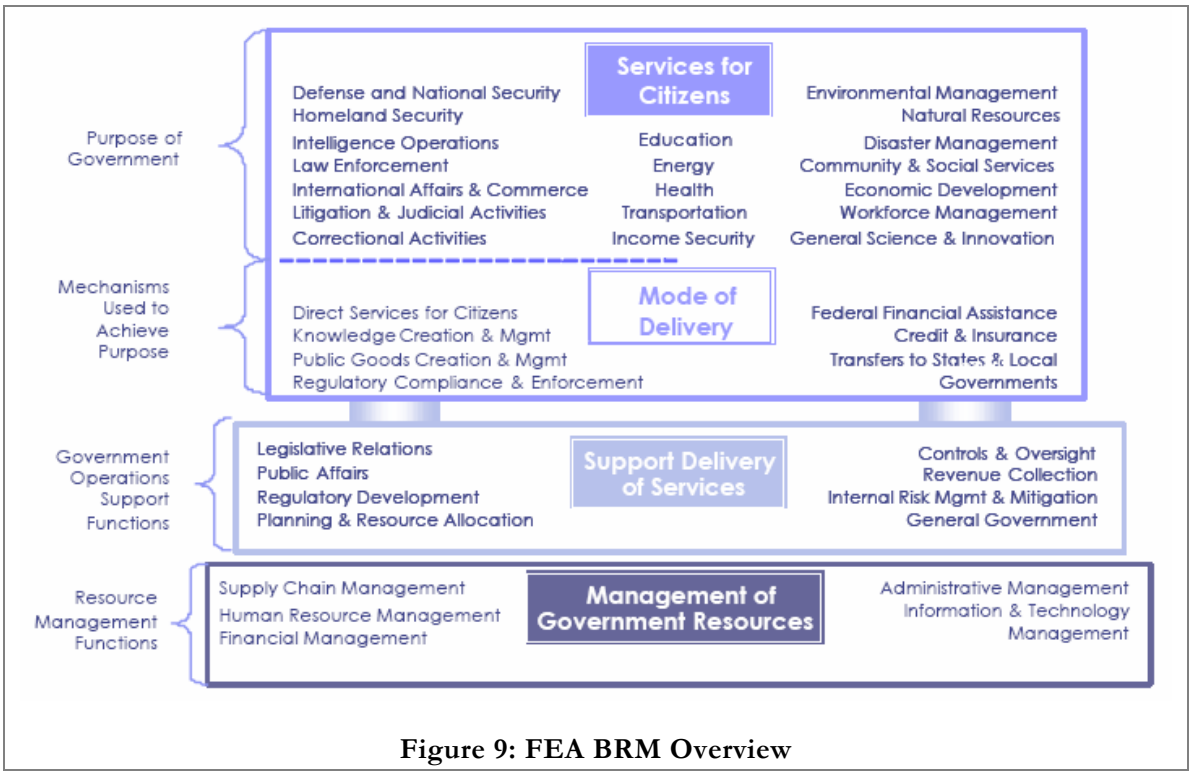

Figure 9: FEA BRM Overview

While a few of the LoBs and Sub-functions (sub-functions are not depicted in Figure 9) may be entirely implemented within a single agency, this is not at all 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 so that OMB can appropriately manage these activities in a cross-

agency environment in order to take advantage of services offered by other agencies that might benefit their business.

2.3.2 The Geospatial Aspects of the FEA Business Reference Model

While there is not an independent geospatial line of business within the FEA BRM, geospatial information serves as a strong integrating force in many human and natural environment processes. Time and space, or when and where things happen (geospatial), are often a common factor in business processes which are seemingly disconnected. They often help organizations and the public understand complex relationships that might be overlooked using traditional 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 disconnected enterprise such as the federal government. An analysis by the GEA CoP Working Group indicated that all 32 Lines of business delineated within the FEA can benefit from location based approaches to some extent.

Appendix C contains a table showing the Business Areas and Lines of Business within the FEA BRM. It then includes a judgment of whether 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 have been used within that Line of Business. For example, under the entry "Financial Management" Line of Business, the GEA CoP Working Group 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 we provide the example that geospatial approaches can be used for tracking and allocation of grants and/or contract dollars by state, congressional districts, or other geographic area and to measure performance against goals. Here we see that the Line of Business does indeed have location content and that it could be utilized to analyze (and potentially improve) the geospatial distribution of grant/contract awards.

The information in Appendix C demonstrates the pervasiveness of location within the business activities of government. Twenty Lines of Business (63%) were identified as having primary geospatial elements. In the "Services for Citizens" lines of business 74% were identified as having geospatial as a primary element. The "Services for Citizens" category represent the purpose or mission of government and are the critical areas where the improved use of geospatial information and technology can significantly increase our 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 mission 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 2.3.4.

2.3.3 How the NSDI relates to the BRM

As stated in the Introduction of this profile, the NSDI is in OMB Circular A-16 as the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data. From a business viewpoint, this 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 BRM, 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 geographic information and related spatial 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 standards, Standards for Digital Geospatial 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 (GOS) 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 GOS. Following these NSDI business practices will enable all organizations to obtain the greatest benefit with respect to the following aspects:

- access to data and service;
- knowledge of data lineage and quality and appropriate data security;
- standards and specifications for interoperability;
- delivery systems with multiple means of delivery; and
- reduction of redundancy and waste as emphasized in Section 1.3 of this document.

2.3.4 Geospatial Aspects of the BRM

In order for an organization to effectively use geospatial data and technologies, they must relate directly to and be embedded within the BRM of the organization's Enterprise Architecture. 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.

This process is predicated on the assumption 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. A list of business functions with associated processes and activities will need to be generated as a critical success factor for developing an enterprise architecture that truly reflects the needs and priorities of the enterprise.

2.3.4.1 Process

The process described in this section is intended to facilitate the identification and definition of the geospatial aspects of any business activity. This process starts with analyzing business activity descriptions to determine possible roles for location-based information in the execution of the business activity. The next step then is to determine the function of geospatial data, technology, and services in carrying out those activities. If a locational aspect of the business activity exists, the next step of the analysis is to 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.

The following list of questions is provided to help the 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 it 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 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 "where" component of 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 form 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 geospatially-enabled business statements (referred to hereafter as 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. Geospatial Business Statements are written in sentence form and use the common definitions/descriptions contained in Appendix E. 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 unit; a geoprocessing user tool; a geospatial service component.
- **Process**—A general business series of 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 E provides an initial list of Geospatial Business Language elements for use by enterprise architects. These elements were adapted from the Department of Homeland Security Homeland Security Geospatial Enterprise Architecture[4] and are provided as an initial 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 our 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 improving reuse in the course of continual architectural evaluation.

[4] http://colab.cim3.net/cgi-bin/wiki.pl?HomelandSecurityGeospatialEnterpriseArchitecture

The section of this document describing the geospatial aspects of the Service Reference Model (see section 2.5) contains the background and reference to an initial list of Geospatial Service Components (Appendix F) 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 Component as this process is being used.

2.3.4.2 Geospatial BRM and the Wildfire Scenario

Our Wildfire Master Use Case 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 like *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 we see that 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 depend upon a detailed knowledge of their *proximity* to the event.

Use Case 2—Implement and Execute Response Plan is a highly complex event which we can only treat 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 we see 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 like 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.

2.3.4.3 Summary

The purpose of the process described in this section is to assist agencies in identifying and describing where geospatial data, technologies, and services can be used to augment or enhance existing business processes. 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.

2.4 Geospatial View of the Data Reference Model (Geospatial DRM)

2.4.1 Scope and Purpose

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. Structuring and controlling the definition of this data will ensure its 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 reuse, accuracy, security and currency thus making the data more shareable than the historic model.

The purpose of this section is to provide:

- Guidance to enterprise architecture authors regarding how to describe geospatial data and metadata
- Guidance on alignment with the FEA DRM while preserving the investments made by the geospatial community over many years

2.4.2 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 representing 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 such as 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 standard encoding methods of locational information. As resources allow, these activities will be coordinated in the future to resolve issues and differences.

Data Description—A standard approach to describing an agency's data resources. This is achieved through the application of the geospatial metadata standard, the Content Standard for Digital Geospatial Metadata (CSDGM, 1998) to describe data sets and collections. The definition of standardized geospatial data elements and constructs is also required for interoperability.

2.4.3 Geospatial support for the DRM

The practices of the NSDI directly support the three standardization goals of the FEA DRM. The geospatial community has been careful in its data management approach to reuse practices from the library and bibliographic community, thereby ensuring interoperability with that wealth of information.

2.4.3.1 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[5], 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), 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 the Earth surface in an of itself provides context, especially when associated with or related to a business terms like "area of interest."

The second main style of geographic or locational property 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. A draft National Address Content Standard is under review and reconciliation by the FGDC and its partner organization, the Urban and Regional Information Systems Association (URISA) to develop a multi-purpose address solution for use nationwide.

[5] 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.

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.

2.4.3.2 Data Sharing

How organizations structure their data holding should enable various data partners to share information based on place or location. Organizing data to be accessed by location enables data sets to be reusable 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.

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.

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**[6], **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.

[6] 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.

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.

2.4.3.3 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 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, which will simplify 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 part is the actual definition of standardized geospatial data elements and constructs that is 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 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. Also, nearly all state and federal geospatial data and metadata are publicly available. 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.

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 archival of data. 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 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[7], and legislative areas. 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 the historic model.

2.4.4 Example use of the Geospatial DRM

> *This sidebar will need to be updated to refer to the Wildfire scenario that is under development for all example sidebars.*

This section outlines the use of the guidance in this Geospatial DRM in the context of the hurricane scenario in Appendix C. In order to support situational awareness and other operational planning, preparation, mitigation, response and recovery requirements, a certain amount of base map information is required. This base map information includes at least some of the following list of data:

- Orthorectified[8] aerial photography or satellite imagery (both historical and current)
- Transportation networks (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.

[7] 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.

[8] 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.

- Demographics—population distribution (day and night-time distribution, if possible), socio-economic data (such as property values)
- Weather—hurricane track and intensity information (relates to predictive rainfall, wind speed, and storm surge information)
- 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 posts locations, fire stations, police stations, emergency operations facilities, etc.
- Alert or warning information—weather alerts and warnings, road condition alert (to include debris obstruction, damage, or destruction/failure information), etc.

In all of the above cases, both the data description and the data sharing mechanism 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. The alert and warning information should be made available using the 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 effort at the Federal, state, and local levels.

Further, we should recognize 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. Included in the metadata for the data should be documentation of online mechanisms for data sharing (such as availability as a web map or as feature data via common standard protocols like WMS, WFS, or even FTP). The metadata should be published into the NSDI via the mechanism described in Use Case 2, Scenario 2.1 (via the NSDI and specifically Geospatial One-Stop Portal, or, if the data is For Official Use Only, via some NSDI-compliant but secure information channel like the Homeland Security Information Network (HSIN)).

2.5 Geospatial View of the Service Component Reference Model (Geospatial SRM)

2.5.1 Scope and Purpose

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, hereafter referred to as 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.
- 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.

2.5.2 Key Terms

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.

2.5.3 FEA SRM

2.5.3.1 Introduction and Overview[9]

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 reuse of business components and services across the federal government.

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

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

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

- 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 below, 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."

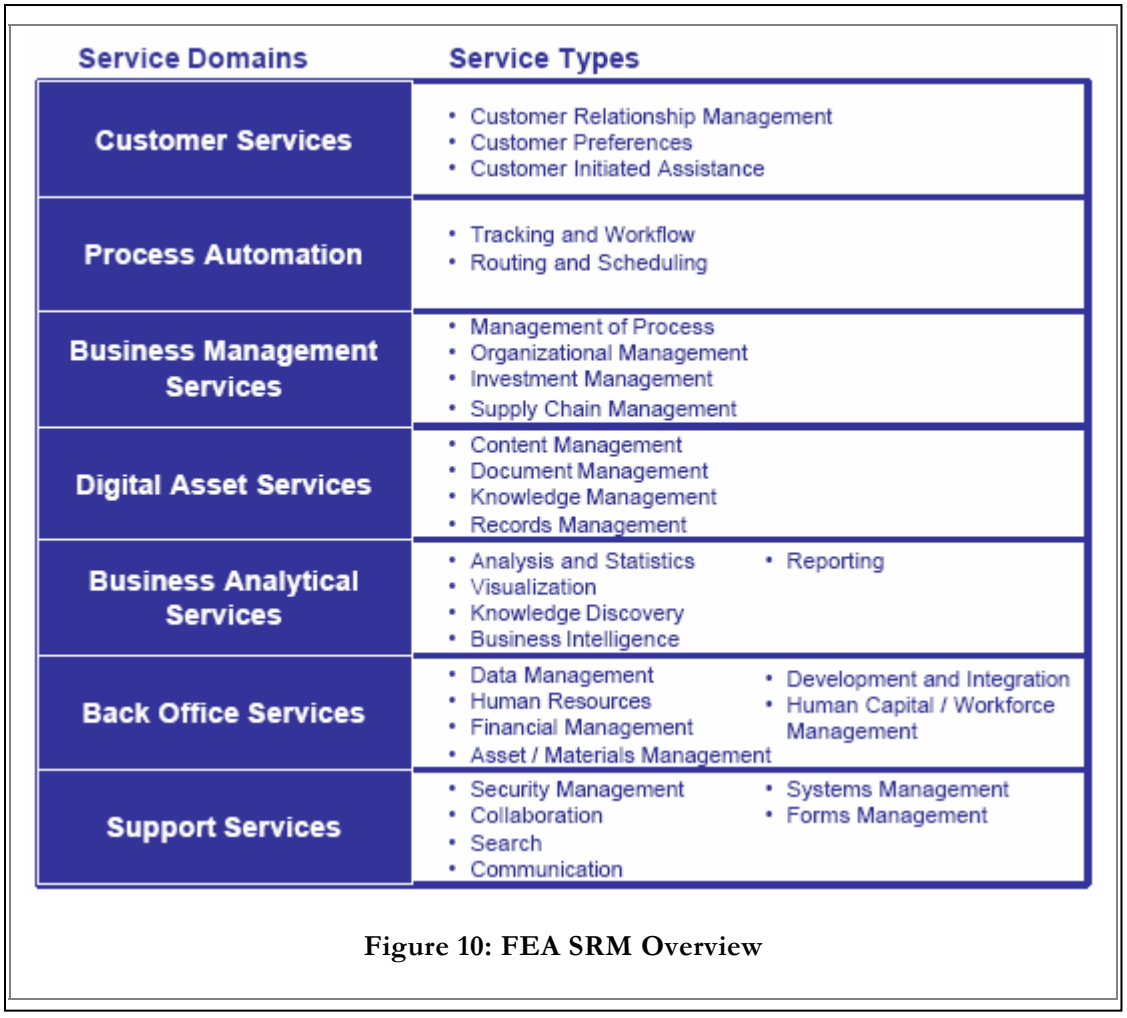

Figure 10: FEA SRM Overview

2.5.3.2 *Introduction to Components*[10]

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

As illustrated in the following table, there are 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.

[10] 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 reuse, and the objectives of the FEA.

2.5.3.3 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 do 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 Geoprofile. For the time being, the approach is to merely map as best we can to the existing SRM, effectively extending the SRM with a level of detail. In a few instances, we recommend changes to the FEA SRM. 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.*

2.5.4 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 1. However, it is possible that we could identify new Service Domains and/or Service Types that would augment the FEA SRM. The primary initial sources for Service Components include the list that FGDC created for the GSA and the DHS Geospatial Enterprise Architecture.*

The table in Appendix F contains Geospatial Service Components that are mapped to the FEA SRM. The first three columns represent the service categories, type 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 2.5.3.2, where BCS represents *Business Component System*, BC represents *Business Component* and DC represents *Distributed Component*. Again, this distinction is important because it reflects ROI, which is important in OMB Exhibit 300 formulation.

The distinction between component levels may be somewhat grey, at first, until the Geospatial SRM is more mature. 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. 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 are 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 [2]. There are also instances where we have created new, recommended FEA Service Components.

2.5.5 Agency Geospatial SRM Development Guidance

The Geospatial BRM (see section 2.3) provides guidance for agency BRM development that will result in the identification of Service Components that are agency-specific and geospatially-enabled. 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.

2.5.5.1 Guidance Concerning Component Granularity[11]

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 and execution of business processes, which in turn sustain the FEA Business Reference Model (BRM) 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.

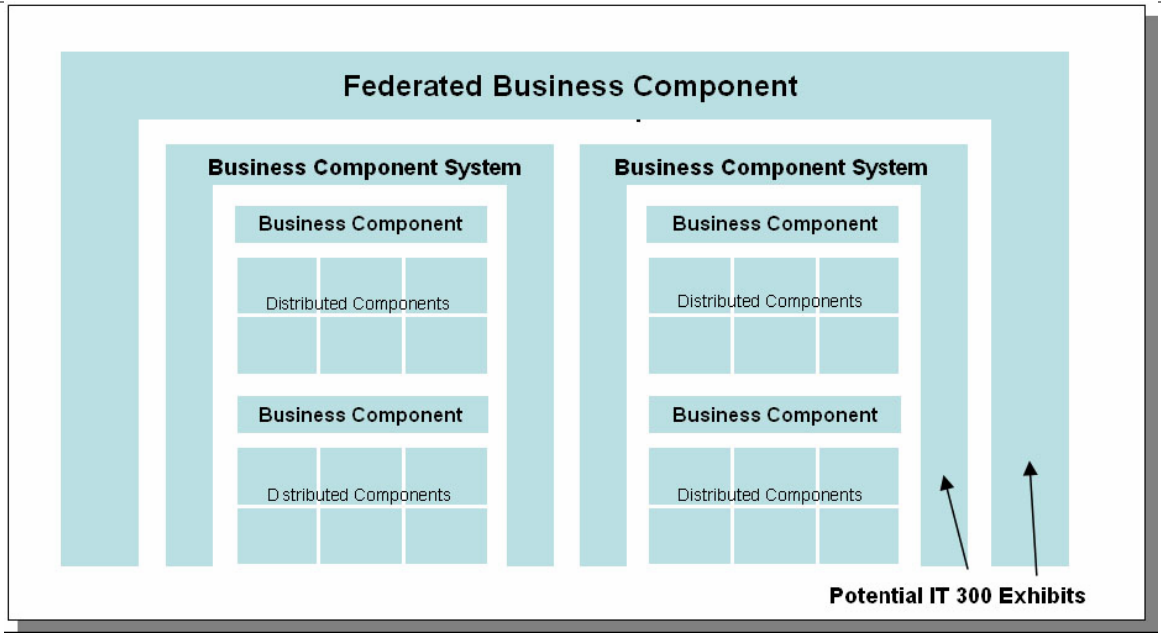

Figure 11: Conceptual Hierarchy of Components

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.

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

2.5.5.2 *Desired Features of a Service Component*[12]

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, which we have taken the liberty of slightly altering 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:

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 interface specifications or standards) between the component and the outside world.

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 impeding the operations of users. A component should be independently developed, delivered, and installed without complex interdependencies on other external components (i.e., keep interfaces functionally simple).

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 reused. As an example, if a component is built using Cobol, reuse 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

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

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 reuse 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 in-advertent 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 reuse would likely be limited. Creating appropriately factored service offerings will significantly increase the breadth of opportunities for reuse of a component.

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 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 reuse of the Component, the

license or SLA terms should be sufficiently broad as to allow the component to be reused 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.

2.5.5.3 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 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 we have specified geospatial versions of these more general FEA components.

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, GPS17 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.

2.6 Geospatial View of the Technical Reference Model (Geospatial TRM)

2.6.1 Introduction

> *NOTE: We plan to add technologies (product categories) in the TRM over the next weeks.*

2.6.1.1 Purpose

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.

2.6.1.2 Goals

Establishing and institutionalizing the Geospatial TRM will provide the guidance and direction the federal 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:

- Promote vendor neutrality through the use of standards-based products and interchangeable services and components,
- Improve interoperability, reuse, and information 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.

2.6.1.3 Intended Uses

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

2.6.2 Standards Profile

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 F.

2.6.3 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.

2.6.4 Approach

The FEA TRM provides a view of technical services, protocols and interfaces 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**.

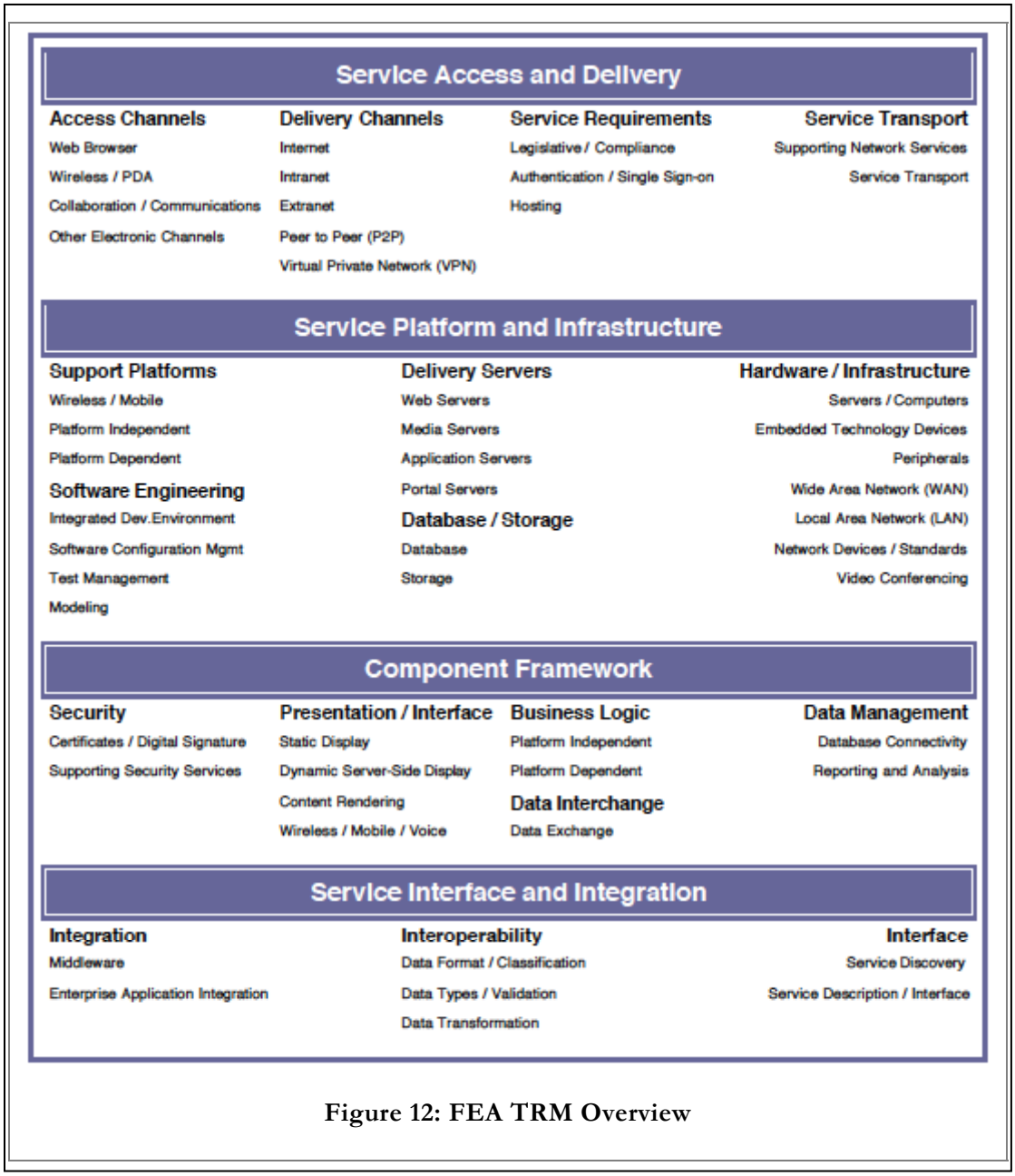

Figure 12: FEA TRM Overview

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.

2.6.5 Service Platform and Infrastructure

2.6.5.1 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, atomic transactions, etc. This level of geospatial awareness, if present, is usually found only in products with native geospatial support.

2.6.6 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.

2.6.6.1 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.

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.

2.6.6.2 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 sending 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 1.0
  - 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 CQL as defined in the OpenGIS Catalogue Interface Implementation

Specification.
5. The datastore 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 0.7
  - https://portal.opengeospatial.org/files/?artifact_id=3837

    Extends 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.

- 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 a group of people representing government agencies, universities, and private companies 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

    Description needed.

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

Description needed.

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

    Description needed.

2.6.7 Service Interface and Integration

2.6.7.1 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 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

  Description needed.

- 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.

2.6.7.2 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
  - http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf

    A shapefile stores nontopological 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

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)

  Description needed.

- 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

  Description needed.

- 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

  Description needed.

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

  Description needed.

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

  Description needed.

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

  Description needed.

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

  Description needed.

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

Description needed.

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

    Description needed.

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

    Description needed.

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

    Description needed.

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.

2.6.7.3 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

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

Service Description / Interface

Defines the method for publishing the way in which web services or applications can be used.

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

Relevant standards:

- OpenGIS® Reference Model (ORM) version 0.1.3
  - http://www.opengeospatial.org/specs/?page=orm

    The ORM describes a framework for the ongoing work of the Open Geospatial Consortium and its specifications and implementing interoperable solutions and applications for geospatial services, data, and applications.

- OpenGIS® Web Service Common Implementation Specification (OGC Common) version 1.0
  - https://portal.opengeospatial.org/files/?artifact_id=8798

    This document 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.

2.6.7.4 Geospatial TRM and the Wildfire Scenario

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

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

Using this information it is easy to locate the **Data Exchange** *Service Standards* that are part of the **Data Interchange** *Service Category*, which in turn is part of the **Component Framework** *Service 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, we can move on to planning the response to the event, 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.

2.7 Geospatial View of the Performance Reference Model

2.7.1 Introduction

Geospatial information and technologies interact and impact at multiple levels within each reference model. The performance methodology for the Geospatial Profile begins with the business sponsor's careful analysis of each reference model to determine the nature, scope, and content of the geospatial services and functions to be provided. Information and data are identified using common terms (geospatial business language) aligned with geospatial objectives (as outlined within the geospatial Lines of Business). These indicators can depict IT measures of geospatial data such as interoperability, accuracy, discoverability, and availability. Measures of integration of business processes such as geocoding, visualization, and spatial analysis must also be assessed. This information must then be transformed into quantitative data through a series of relevant questions and answers that assist business sponsors in understanding the geospatial nature, or elements, of the processes they are designing or re-engineering. Whenever new geospatial services are established, or an existing service is spatially-enabled, an assessment should be conducted benchmark then track the impacts of these initiatives. This methodology can be used by both the business sponsor as well as the stakeholder.

This initial draft of geospatial components for the Performance Reference Model defines categories of success related to business outcomes. The performance categories arise from the broad geospatial community of practice as it has evolved to try to monitor these same areas. Many of these approaches related to a single categorical element such as '*coordination'* and the National States Geographic Information Council's (NSGIC) *Coordination Model*. The performance model described in this section combines activities and experiences from all sectors (federal, state, local, tribal, and private) into a single assessment forum for geospatial integration. This categorization and associated development of specific metrics needs to evolve as this model is applied, reviewed, and refined.

The geospatial services within a business process or IT system should be designed to support measures of outcome attainment. Hence, measures will need to be developed for the geospatial technologies, information, and services that can link them to successful business outcomes. Ultimately, performance information obtained from across all of the FEA models builds toward the development and implementation of effective business processes to serve citizens. Interoperability, accuracy, discoverability, and availability attributes and assessment as well as business process goals will be included as critical elements in the performance model, along with the ability to assess improvements based on a maturity model for architecting these technologies and services.

2.7.2 Overview of the FEA Performance Reference Model

The Performance Reference Model (PRM) helps agencies measure the performance of major IT investments and their contribution to agency performance. The objectives of the model are to enhance performance information; improve the alignment and better articulate the contribution of inputs (such as technology), to outputs and outcomes; and identify improvement opportunities that span organizational boundaries.

The model (illustrated in *Figure 1,* below) is comprised of six Measurement Areas. Four of these areas are outlined below and addressed by the PRM.

1) *Mission and business results* – to capture the outcomes that agencies seek to achieve.

2) *Customer results* – to capture how well an agency or specific process within an agency is serving its customers.

3) *Processes and activities* – to capture the outputs that directly result from the processes that IT initiatives support.

4) *Technology* – to capture key performance elements directly associated with IT initiatives.

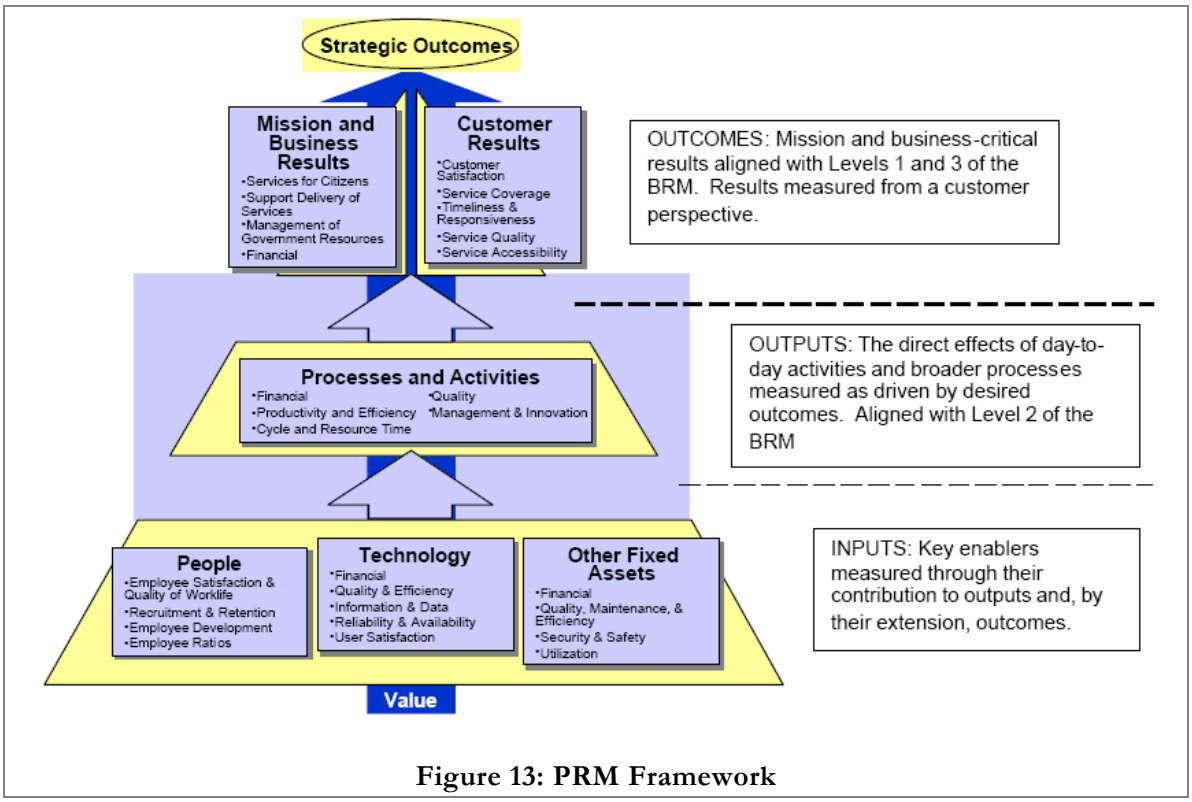

Figure 13: PRM Framework

Each Measurement Area includes Measurement Categories, which are decomposed into generic Measurement Indicators that agencies can tailor to reflect their own environments.

2.7.3 Geospatial PRM approach

The approach for the geospatial PRM follows the suggested FEA PRM implementation. The process acknowledges that initiatives must be developed in a business-driven context to be truly successful. As with all aspects of the PRM, the suggested process must be refined and improved as lessons are learned over time.

How any program, service or integration initiative aligns with the organization's Business Reference Model provides the starting point to "operationalize" the appropriate measurement indicator. Agencies should leverage this Geospatial Profile to align their initiatives to the geospatial Lines of Business and Sub-functions (Appendix D) that their initiative requires. Key context and background information also includes relevant legislative and Congressional mandates for geospatial initiatives and/or the programs it supports (Appendix H).

A first step in aligning geospatial integration with the PRM is to understand the geospatial elements contained within the *line of sight*. Geospatial initiatives should be developed and driven in the context of the organization's mission and it's related outcomes and outputs. Developing a *line of sight* can be especially useful for intra- and inter-governmental geospatial integration initiatives. The *line of sight* can articulate what aspect of each participating organization plays a role. Agencies can use geospatial technologies to complement existing IT portfolios or help create new portfolios around business lines, customers, processes, or services.

At its essence the *line of sight* consists of thinking through two aspects critical to identifying measurement indicators: (1) WHAT does geospatial contribute to performance within the *line of*

sight?, and (2) HOW do information or technology elements in the *line of sight* relate geospatially?

To determine WHAT in the *line of sight* is geospatially relevant, the geospatial BRM section provides geospatial business language and terms (Appendix E) as well as process questions. Once relevancy is established, the geospatial services and analyses to support the IT business and operational functions can be demonstrated, benchmarked, and documented—specifically how the geospatial initiative can enhance, enable, leverage, and visualize or provide support services for integration initiatives.

To determine HOW each element in the *line of sight* relates geospatially, it is important to concede that disparate data can be functionally linked through their juxtaposition on the Earth's surface. Using this spatial attribute of data can allow for data to be queried, accessed, analyzed, summarized, and visualized with in the context of location. In summary, the *line of sight* uses the PRM structure to identify what the geospatial initiative does, how it does it, and how it can be measured.

Against the backdrop of the information identified above, geospatial PRM measurement categories have been identified. They have been compiled in the form of a **Geospatial Integration Maturity Model**. The categories of interest include:

- *Coordination* —The level of facilitation, coordination, and collaboration in place regarding geospatial leadership for an organization.

- *Governance, Management, & Planning* — The existence and evolution of plans and strategies for developing or leveraging the geospatial components of their business data.

- *Data Acquisition, Documentation, & Maintenance* —The stage of implementation regarding geospatial data lifecycle processes such as development, documentation, and maintenance.

- *Standards & Best Practices* —The level of adoption and compliance with geospatial technology and process standards related to their business drivers.

- *Data Access & Distribution* —The existence and continuing development of geospatial data holdings, their discoverability, searchability, and accessability.

- *Policies & Compliance* —The development 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.

- *Training and 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 their mandated activities.

The degree of commonality or standardization across an organization's use of these measures will depend upon whether the geospatial initiative is being managed by a single organization or multiple organizations. PART guidance notes that performance measures should reflect a sense of prioritized achievement and should reflect both outcomes and outputs. For each category the range of possible geospatial indicators has been identified and categorized along a continuum expressed as levels 0 through 5, with fives equating to levels of high achievement for that category.

Specific criteria for individual Measurement Indicators within each *Maturity Model* category would require that the indicator be informative, feasible to capture, manageable, actionable, and complete. Finally, the point of performance measurement is to standardize integration thereby reducing uncertainty in implementation. This means that particularly in the early years of this *Geospatial Integration Maturity Model* assessment, agencies will not have perfect measures. This *Maturity Model* is not about perfect measures, but better measures that provide appropriate direction, objectives, and goals for project managers and key decision-makers.

Utilizing this *Maturity Model*, a baseline of the current state of geospatial integration can be measured and documented. Conducting this baseline analysis will allow a reference point to be set from which improvement targets can be determined and progress then measured. Once the relevant baselines are established, the next step is to use that context along with some additional information to set performance targets for each geospatial *Maturity Model* category identified. Performance targets will need to be quantifiable estimates or expected results bound to 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 areas of the *Maturity Model*. The improvement targets set against each relevant indicator then serves as the measuring stick for progress on these various fronts. Once collected the performance information facilitated by the *Maturity Model* can be used in targeted circumstances to drive more rigorous analysis to support decision-making. The important point is to use the information provided by progress towards *Maturity Model* goals to make better decisions, and as necessary, assess and re-assess the organization's path forward.

2.7.4 Geospatial Integration Maturity Model

2.7.4.1 General Maturity Levels

Level 0—No Program

There is not a documented geospatial integration profile in place at this level of maturity. While geospatial solutions are developed and implemented, this is done with no recognized use of standards or base practices. The organization is completely reliant on the knowledge of individual geospatial specialists.

Level 1—Informal Program

The base geospatial architecture framework and standards have been identified but are typically performed informally. There is general consensus that these steps should be performed, however they may not be followed and are not tracked. Organizations with a geospatial integration profile at this level are still dependant on the knowledge of individual geospatial specialists.

Level 2—Repeatable Program

The base geospatial architecture and standards have been defined and are being tracked and verified along business lines. At this point in the program, geospatial processes are repeatable and reusable templates and components are starting to be developed. The need for product and

compliance components to conform to the standards and requirements has been agreed upon, and metrics are being developed and used to track progress toward integration goals and objectives.

Level 3—Well-Defined Program

The geospatial enterprise architecture profile is well defined; using approved standards and/or customized versions of processes or templates. Geospatial processes and services are documented across the organization. Performance metrics are being tracked and monitored in relationship to other general practices and business lines.

Level 4—Managed Program

At this point performance metrics are collected, analyzed and acted upon. The metrics are used to predict performance and provide better understanding of the geospatial processes and capabilities and their impact on the lines of business and the organizations mandated activities.

Level 5—Continuously Improving Vital Program

The geospatial processes are mature; targets have been set for effectiveness and efficiency based on business and technical goals. There is continued diligence on operational aspects of the geospatial integration of the organization but the organization's context within the larger national geospatial framework is understood and pursued. There are ongoing refinements and improvements based on the understanding of the impact that changes in these technologies have on these geospatial processes and programs.

2.7.4.2 Geospatial Integration Maturity Model Categories

0 *Coordination*

Level 0

- No Geospatial Coordination is in place. Geospatial Information Technology is viewed as a project element and activities are pursued and conducted independently by various individuals, agencies, organizations, and government sectors on a project-by-project basis.

Level 1

- Project-based Coordination wherein independent groups recognize or share a common need where the development of spatial information is a common goal. A vested leader for the group emerges to push the project along and perform the coordination necessary to achieve the desired goal. Once completed, the group dissolves and independence is once more the norm.

Level 2

- Volunteer Coordination relies on an individual to take the lead for the integration of geospatial technologies or where the development of spatial information is a common goal. This leader performs the coordination necessary to move the organization to the desired goal. In many cases this coordination occurs with no predictable pattern or frequency as the volunteer has no time or latitude for such activity.

Level 3

- Unofficial Single Department Coordination: This coordination model can be effective, but it is generally dependent on key individuals who have received their department's blessing to conduct these activities. Being vested within a specific department can also bring perspectives more narrowly defined than are necessary for effective enterprise geospatial coordination. The likelihood that this level of

facilitation and coordination will be maintained when that person leaves or when there is a change in leadership within the organization, is very low.

Level 4

- Official Coordination through a Geospatial Information Officer (GIO): This method of coordination has become increasingly popular and is generally most effective. This model provides the greatest assurance that required enterprise coordination work will be identified and completed to the extent granted by the authorizing mandate. Many offices are not always empowered to address all of the required issues so care must be taken in the development of the language establishing its authority.
- Coordination roles and responsibilities may include: Assessing needs and identifying geospatial investment priorities; Ensuring cost efficient and open access to spatial data and technology resources; Establishing appropriate data standards and ensuring compliance; Establishing appropriate data access and sharing policies; Coordinating data production, maintenance, documentation and delivery; Establishing Mapping Services; Establishing an FGDC compliant Clearinghouse Node (data & metadata); and Coordinating the development of geospatial applications.

Level 5

- Official Coordination through a Geospatial Information Officer (GIO): Coordination roles and responsibilities are reviewed and updated, such functions may include: extended coordination functions outside of the resident agency between federal, state and local agencies; Establishing and maintaining budgetary authority to collect and distribute funds; Establishing and maintaining authority to form partnerships with other levels of government, non-profit organizations, utilities and private organizations; Providing a non-lapsing fund for priority data and system development projects; Providing contractual authority; Offering suitable expertise on technical, management, and policy issues.

o *Governance, Management, & Planning*

Level 0

- No plans for developing or leveraging the geospatial element of the data with the technologies are in place

Level 1

- Need for geospatial enablement of their information holdings has been identified
- Geospatial activities are informal and unstructured

Level 2

- The organization has begun to develop a vision for how a geospatially enabled database structure and geospatial technologies can enhance support for the organization's business goals and objectives while providing efficiencies in business process workflow.
- The organization has begun to identify geospatial elements, tasks, and related business lines and their associated resource requirements.
- The organization has begun to develop a plan for their geospatial program elements to bring them to the enterprise.

Level 3

- Geospatial enterprise plans are well-defined and go beyond data retrieval by providing plans for analysis, interpretation, and display of information to observe relationships, patterns, or trends that were not possible to visualize with traditional charts, graphs, and spreadsheets.
- Geospatial governance roles and responsibilities have been outlined.
- A structured framework and timeline for developing the geospatial enterprise have been established.
- Financial and staffing resource requirements have been outlined.
- The geospatial enterprise activities are carried out according to the defined plan.

Level 4

- The geospatial plans are reviewed against business lines and programmatic mandates and changes are incorporated to improve the organization's overall enterprise program.
- The organization captures metrics to measure the progress of the plan against the established geospatial goals, objectives, and task elements.
- Strategic planning is taking place to set goals for future evolution of the overall Enterprise Architecture Program Plan with the geospatial being an implicit element of those discussions.

Level 5

- Geospatial action plans are proactively developed and implemented to increase the effectiveness of the overall Enterprise Architecture Program based on captured metrics and opportunities presented among shared business lines.
- The organization works with other federal agencies, states, tribes, and local governments to share ideas with a focus on improving the national geospatial profile and framework.

o *Data Acquisition, Documentation, And Maintenance*

Level 0

- Information development processes and geospatial data are not documented nor are they maintained.

Level 1

- Geospatial data development processes are ad hoc and informal, processes followed may not be consistent among departments, maintenance processes are ad hoc and informal.
- There are no unified processes or geospatial data element standards utilized across the geospatial technologies nor among the organization's lines of business.

Level 2

- Basic FGDC compliant geospatial metadata is collected and documented.
- Data acquisition standards are utilized and processes are planned and tracked for quality assurance and quality control reporting.
- The organization is beginning to employ maintenance methods for capturing and providing back-up of time-critical geospatial information elements.

Level 3

- The geospatial data lifecycle processes have been defined and documented for the organization to include stewardship roles and responsibilities as well as archival rules and retention.
- Standardized data acquisition and development processes are being used as the foundation for other agencies, departments, etc. to ensure interoperability.
- FGDC compliant geospatial metadata templates are being used to ensure that the capturing of information is consistent.

Level 4

- The organization routinely captures metrics to measure the effectiveness of the geospatial data development and maintenance processes against business objectives.
- The organization routinely captures metrics to measure the effectiveness of the geospatial data documentation templates against business requirements.
- Corrective action plans are put in place when deficiencies in templates and/or procedures are identified or as geospatial technologies evolve or sunset.
- Intra-governmental meetings are held regularly to review status and goals of the mandated data development activities in relation to the NSDI Framework.

Level 5

- The geospatial lifecycle processes are being followed and have become second-nature within the organization.
- Captured metrics are used to identify inefficiencies in data development or acquisition processes prior to notification of issues.
- Organization shares with other federal, state, tribal, and local governments it's ideas for improvements to geospatial processes and templates.
- Intergovernmental meetings are held regularly to review status and goals of the mandated data development activities in relation to the NSDI Framework.

o *Standards & Best Practices*

Level 0

- Documentation of business drivers for geospatial technology implementation are unknown.
- Geospatial technology standards and best practices are unknown or not followed.

Level 1

- Documentation of business drivers for geospatial technology implementation are informal.
- Technology standards and best practices utilized are informal and inconsistent.

Level 2

- Business drivers and strategic information related to geospatial elements, technologies, processes, and data have been identified.
- The need for a repository for storage and dissemination of standards and best practices for geospatial information has been identified.

Level 3

- Use of existing geospatial technology standards is consistent within the organization.

- Documentation of geospatial business drivers and strategic information leads to an inventory of needs related to standards and best practices.

Level 4

- Documentation of geospatial aspects of business drivers and strategic information has become a standard operating procedure.
- Documentation and use of geospatial standards and best practices has become familiar within the organization.
- The organization captures metrics from the compliance process to identify the need for updates to the geospatial business information, technology change's impacts on protocols, and migration / evolution strategies for implementation planning.

Level 5

- Captured business and technology information is reviewed in conjunction 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.
- The organization works with other federal, state, tribal, and local governments to share information regarding best practices.
- The organization works with other federal, state, tribal, and local governments to share information regarding general approaches to supporting the implementation of new geospatial business and technology trends, standards, and best practices.

o *Data Access & Distribution*

Level 0

- Management and departments are not aware of what geospatial data and information is present or the benefits of knowing.

Level 1

- The need to create greater awareness about geospatial assets has been identified.
- Little is known or shared about the geospatial assets or possible distribution methods and improvements.

Level 2

- The need for geospatial data discoverability is being communicated to management.
- Geospatial data awareness and distribution activities are beginning to emerge or be developed.

Level 3

- The geospatial data holdings are well defined and their existence communicated.
- Interagency data sharing and distribution agreements are being formulated.
- Interdepartmental access and distribution activities are developed.

Level 4

- Geospatial data holdings are digitally available and searchable through an FGDC metadata clearinghouse node.
- Data sharing and distribution agreements are in place to improve the communication and exchange geospatial data.
- Intergovernmental access and distribution activities are developed.

- The organization captures metrics to measure the extent and effectiveness of the data discoverability, access, and distribution activities.

Level 5

- Metrics are used to proactively identify opportunities for improved data services.
- Geospatial data holdings are digitally available, searchable, and downloadable through an FGDC data clearinghouse node.
- Extensive data sharing and distribution agreements are in place to improve the communication and exchange of geospatial data.
- Intergovernmental access, distribution, and update activities are deployed.
- The organization works with other federal, state, tribal, and local governments to share ideas for improvements to the national geospatial clearinghouse.

o *Policies & Compliance*

Level 0

- No geospatial compliance process exists within the organization. OMB Circular A-16 as an organizational mandate is largely ignored.

Level 1

- The need for compliance to geospatial standards has been recognized as outlined in OMB Circular A-16.
- Compliance is informal and unstructured.
- Compliance cannot be measured effectively because processes and procedures are not consistent across areas and/or implementations.

Level 2

- The organization has begun to organize a compliance process to ensure that all projects and business line implementations utilizing geospatial data and information are consistent with the geospatial standards adopted by the organization and outlined within OMB Circular A-16.

Level 3

- A formal geospatial compliance process is well defined and is an integral part of the geospatial data lifecycle processes.
- A formal geospatial compliance process is well defined and is used as a filter for the development and review of proposals for application or data development within the organization.
- A waiver request and business justification is required for variance from the adopted geospatial standards.

Level 4

- Compliance to geospatial standards has become common practice throughout the organization.
- Quality metrics associated with geospatial-related business cases are captured.
- The geospatial compliance process is continually reviewed and updated as deficiencies or enhancements to the process are identified.

Level 5

- Information gathered during the compliance process is used to proactively identify updates to geospatial standards and/or policies.
- Compliance metrics are used to drive continuous process improvements in the Business Cases as well as define opportunities for leveraging activities.
- The organization works with other federal, state, tribal, and local governments to share ideas for improvements to the compliance process as it relates to the geospatial elements and technologies it embodies.

o *Enterprise Integration*

Level 0

- No program in place for geospatial integration across the enterprise IT environment.

Level 1

- The role that geography or location plays as a central organizing principle in a line of business has been recognized and critical data model elements have been identified.
- Geospatial projects, purchases, and applications are typically developed in isolation resulting in redundant acquisitions, development, and training.

Level 2

- The need for geospatial integration to the overall enterprise architecture effort across lines of business and services has been identified.
- The various touch-points between the geospatial components (technologies, standards, processes, services, analyses, etc.) and lines of business and outcomes have been mapped (however, no details exist as to how the integration will take place).

Level 3

- The geospatial aspects of the organization's architecture program is integrated with strategic planning, as well as review and approval within the budgeting process.
- Touch-points of business lines and processes utilizing geospatial elements and components have been well defined to enable higher levels of information integration, analysis, and presentation.

Level 4

- The organization's enterprise architecture is used to guide geospatial development and acquisition.
- The organization captures metrics to measure the savings in resources, including time and money, through the leveraged use of geospatial technologies within their data models, applications, and data base systems.
- Costs and benefits of geospatial integration within the IT environment, including benefits across agency boundaries, are considered in identifying projects.
- Geospatial technologies are enhancing decision-making and stream-lining business processes while adding significant analytical capabilities to the enterprise IT environment.
- Geospatial integration procedures are reviewed and processes updated when problems or new functionality is identified.

Level 5

- The organization's enterprise architecture process is fully engaged with geospatial functionality that drives continual evolution of geospatial initiatives throughout the enterprise.
- The organization's lines of business influences the geospatial technology deployed and the geospatial technology influences how and what can be delivered along business lines.
- Captured metrics are used to proactively identify improvements to the geospatial integration processes.
- The organization works with other federal, state, tribal and local governments to share ideas for improved geospatial integration, including the areas of procurement, project management practices, application development, and system administration.

o *Training And Skills Development*

Level 0

- There is no program in place for geospatial awareness education.
- Several independent groups or individuals typically work to solve a single geospatial issue.

Level 1

- The organization has identified the need to inform staff throughout the enterprise of the benefits and concepts of a geospatially enabled enterprise architecture.
- Geospatial awareness efforts are informal and inconsistent and may be met with skepticism or indifference.

Level 2

- The organization has begun to develop plans for geospatial training and educational sessions to increase the awareness and understanding of what a spatially enabled enterprise can do for the organization.
- Geospatial concepts and functionalities are beginning to be introduced and more consistently discussed in normal day-to-day meetings.

Level 3

- The geospatial operations of the organization begins to operate as a team, using the defined architecture program and adopted / adapted geospatial standards.
- Management briefings have occurred to inform and create champions for the geospatial integration efforts.
- Both business and technical staff understand and promote the appropriate use of geospatial technologies in addressing needs and requirements for the lines of business mandated by the organization.

Level 4

- Personnel throughout the organization have a good understanding of the geospatial principals and can utilize and develop projects to leverage this aspect of their data across the enterprise.
- The organization captures metrics to measure the awareness, participation, acceptance and satisfaction with the geospatial integration effort.

Level 5

- Cross-agency personnel work together as contributors to the spatially enabled architecture and its shared services.
- The organization uses the captured metrics to proactively create action plans for the further expansion of geospatial applications in the business of the organization.
- The organization cooperates with other federal, state, tribal, and local governments in a peer-to-peer forum to share ideas for creating an atmosphere for active involvement, promotion, and deployment of geospatial education, information, application and service support across the national geospatial enterprise.

Appendix A: References

[1] The Service Component Reference Model (SRM), OMB Federal Enterprise Architecture Program Management Office (FEA PMO). http://www.whitehouse.gov/omb/egov/a-4-srm.html

[2] FEA Consolidated Reference Model Document, FEA PMO, May, 2005. http://www.whitehouse.gov/omb/egov/documents/CRM.PDF

[3] Service Component-Based Architectures, Version 2.0, Federal CIO Council, Architecture and Infrastructure Committee, June, 2004. http://www.cio.gov/documents/CIOC_AIC_Service%20Component%20Based%20Architectures%20_2.0_FINAL.pdf

[4] Enterprise Architecture Assessment v1.0 Frequently Asked Questions (FAQs), OMB FEA PMO, May, 2004. http://www.whitehouse.gov/omb/egov/documents/EA_Assessment_FAQs.PDF

[5] United States Department of Energy, Office of Management, Budget and Evaluation (OMBE); Enterprise Architecture: APPLICATION LAYER, December 30, 2003. http://www.mbe.doe.gov/ME2-5/I-MANAGE/OMBApplicationLayer.doc

[6] National Information Exchange Model (NIEM), a joint DOJ/DHS initiative. http://niem.gov/default.php

Appendix B: Terminology (Glossary)

NOTE: Thus far, only the SRM has contributed to this glossary. We need to gather the inputs to this glossary from the BRM, PRM, DRM, and TRM over the next weeks

Some of these glossary entries will find their way into the FEA glossary (some even came from that source) or will be harmonized with those terms. Some will stay.

Component – 1) Independently deployable unit of software that exposes its functionality through a set of services accessed via well-defined interfaces. A component is based on a component standard, is described by a specification, and has an implementation. Components can be assembled to create applications or larger-grained components. [Source: CIO Council, FEA PMO]; 2) A self contained business process or service with predetermined functionality that may be exposed through a business or technology interface. [CIO Council, FEA PMO] (See Service Component)

Coverage – 1) A coverage associates positions within a bounded space to a continuum of feature attribute values. Examples include a raster image or a digital elevation surface. [FGDC]; 2) A feature that associates positions within a bounded space (its spatiotemporal domain) to feature attribute values (its range). Geospatial coverages (including the special case of Earth images) are two- (and sometimes higher-) dimensional metaphors for phenomena found on or near a portion of the Earth's surface. A coverage can consist of a set of features or Feature Collections. Earth images are seen as Grid Coverages that contain features whose geometries are of type "set of cells" or "set of pixels" (surfaces). [OGC] (See Feature)

E-Business Patterns – Patterns for e-business are a group of proven reusable assets that can be used to increase the speed of developing and deploying net-centric applications, like Web-based applications. [CIO Council, FEA PMO] (See Patterns)

Feature – 1) The conceptual representation of a geographic entity, e.g., city, temperature, tree, bridge. [FGDC]; 2) The starting point for modeling of geographic information. Abstraction of a real world phenomenon. A digital representation of a real world entity or an abstraction of the real world. It has a spatial domain, a temporal domain, or a spatial/temporal domain as one of its attributes. Examples of features include almost anything that can be placed in time and space, including desks, buildings, cities, trees, forest stands, ecosystems, delivery vehicles, snow removal routes, oil wells, oil pipelines, oil spill, and so on. Features are usually managed in groups as feature collections. The terms feature and object are often used synonymously. The terms feature, feature collection and coverage are defined in line with OpenGIS. [OGC]

Geospatial – 1) Referring to location relative to the Earth's surface. "Geospatial" is more precise in many geospatial information contexts than "geographic," because geospatial information is often used in ways that do not involve a graphic representation, or map, of the information. [Source: OGC]; also 2) Refers to the broad set of information and technology involved in measuring, modeling and exploiting the earth, natural and manmade features and other earth phenomena. [DHS]

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

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)

Shared Service – Architectural elements (business processes and/or technology components) that are used by multiple organizations within the enterprise. [FEA PMO] (See Service)

Service – 1) Discrete unit of functionality that can be requested (provided a set of preconditions is met), performs one or more operations (typically applying business rules and accessing a data-base), and returns a set of results to the requester. Completion of a service always leaves business and data integrity intact. [CIO Council, FEA PMO]; 2) A computation performed by a software entity on one side of an interface in response to a request made by a software entity on the other side of the interface. A collection of operations, accessible through an interface, that allows a user to evoke a behavior of value to the user. [ISO]

Service Component – 1) 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 [CIO Council, FEA PMO]; 2) A Component; 3) One or more closely related Services. Within the context of the FEA SRM, a low-level software object/class does not qualify as a Service Component. A Service Component in the SRM has a clear functional business role and should be a shared resource for many enterprise users. (See Component and Service)

Service-Oriented Architecture (SOA) – Architecture that provides for reuse of existing business services and rapid deployment of new business capabilities based on existing capital assets. [CIO Council, FEA PMO]

Pattern - Frequently occurring combination of business and technical elements that can be used to deliver re-useable business services across the enterprise.

Appendix C: Use Case

Scope and Purpose

One of the primary goals in developing the Federal Enterprise Architecture is to design information systems that work well together, leading to better, quicker decision making at lower cost. This section provides business and functional context to the FEA Geospatial Profile by introducing a set use cases and scenarios that illustrate how this profile, when properly implemented, can support interoperability and data re-use across agencies and levels of government.

> *NOTE: This appendix needs further work.*

Definitions

> *"In software engineering, a **use case** is a technique for capturing the potential requirements of a new system or software change. Each use case provides one or more **scenarios** that convey how the system should interact with the end user or another system to achieve a specific business goal. Use cases typically avoid technical jargon, preferring instead the language of the end user or domain expert. Use cases are often co-authored by software developers and end users[13]."*

In the FEA Geospatial Profile, we will adopt the basic definition above with the following adjustments:

Master Use Case—an abstract, high-level use case that is intended to provide a business requirements context for the use cases that will be used in the FEA Geospatial Profile.

Use Case—a more concrete use case that is intended to provide a functional requirements content for the FEA Geospatial Profile effort by looking at a hypothetical system within the Master Use Case business context.

Scenario—an element of a use case that conveys how a hypothetical system should interact with the end user or another system to achieve a specific use case sub-functional goal.

Master Use Case

This section provides a complete description of the Master Use Case for the FEA Geospatial Profile. It includes background on the following lines of business, on catastrophic incident response, and then outlines use cases in an industry-standard fashion:

- Community and Social Services: Homeownership Promotion; Community and Regional Development
- Disaster Management: Disaster Preparedness and Planning; Disaster Repair and Restore; Emergency Response
- Environmental Management: Environmental Monitoring and Forecasting
- Health: Population Health Management and Consumer Safety; Health Care Administration

[13] Wikipedia, http://en.wikipedia.org/wiki/Use_case, July 2005

- Public Affairs: Customer Services; Official Information Dissemination

Background—Scenario Lines of Business

The following descriptions of Lines of Business from the FEA BRM are provided for immediate context:

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.[14]"*

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 nonregulated emissions, as well as the observation and prediction of weather patterns and conditions.*

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

- ***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.*

In the Master Use Case for the FEA Geospatial Profile, we will focus on the Disaster Preparedness and Planning and Emergency Response sub-functions. These sub-functions are strong Master Use Case candidates because:

- Disaster preparedness, disaster planning, and emergency response often requires multi-level, multi-agency, multi-jurisdictional collaboration and support and thus provides excellent business and functional context for the information sharing and interoperability in a geospatial context.
- Emergency response has a heavy command and coordination element and thus provides excellent business and functional context for a situational awareness capability to deliver a location-based understanding of response resources including their disposition and movements.
- Disaster preparedness, disaster planning, and emergency response often depends on understanding the interaction of disaster-related phenomena and the natural and built environment and thus requires a comprehensive, geospatially-enabled understanding of both

of these elements. This provides excellent functional and business context for the use of science-based models as they relate to the event at hand.

- Disaster preparedness, disaster planning, and emergency response is covered by a vast and well-known body of lessons learned and standard operating procedures, including the National Incident Management System (NIMS) and the National Response Plan (NRP), that provide an excellent framework of documentation that we can reuse in our use cases.

While the focus will be on Disaster Preparedness, full understanding of the architecture's significance requires looking beyond this one Line of Business. In this scenario we look at the community in which the event occurs to see how Community and Regional Development and Homeownership Promotion efforts are informed and enhanced, we look at Health Care Administration to illustrate how these information sources can help emergency responders reach people who likely are unable to help themselves, and we look at Population Health Management as a follow-on activity after the crisis is resolved.

Finally, we examine the interaction with the public at large. Unlike the previous lines of business, which all fall under the Services to Citizens business area, here we look at the Support Delivery of Services business area, and explore the geospatial characteristics of the Public Affairs line of business. Identifying affected interest groups and preparing effective media for them can be greatly enhanced through the use of

Background—Catastrophic Incidents

A catastrophic incident, as defined by the NRP, is any natural or manmade incident, including terrorism, which results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions. A catastrophic incident could result in sustained national impacts over a prolonged period of time; almost immediately exceeds resources normally available to State, local, tribal, and private-sector authorities in the impacted area; and significantly interrupts governmental operations and emergency services to such an extent that national security could be threatened. All catastrophic incidents are Incidents of National Significance. These factors drive the urgency for coordinated national planning to ensure accelerated Federal/national assistance.

The Catastrophic Incident Annex to the National Response Plan (NRP-CIA) establishes the context and overarching strategy for implementing and coordinating an accelerated, proactive national response to a catastrophic incident.

The NRP-CIS provides a list of the specific actions that are initiated upon activation of the NRP-CIA. The following Federal departments and agencies and other organizations are assigned specific responsibilities as cooperating agencies:

- Department of Agriculture
- Department of Defense
- Department of Energy
- Department of Health and Human Services
- Department of Homeland Security
- Department of Transportation
- Department of Veterans Affairs

- Environmental Protection Agency
- American Red Cross

Departments and agencies assigned primary responsibility for one or more functional response areas under the NRP-CIS appendixes are identified below.

- **Mass Care:** American Red Cross
- **Search and Rescue:** Department of Homeland Security
- **Decontamination:** Department of Homeland Security, Environmental Protection Agency, and Department of Health and Human Services
- **Public Health and Medical Support:** Department of Health and Human Services
- **Medical Equipment and Supplies:** Department of Health and Human Services
- **Patient Movement:** Department of Health and Human Services and Department of Defense
- **Mass Fatality:** Department of Health and Human Services
- **Housing:** Department of Homeland Security
- **Public and Incident Communications:** Department of Homeland Security
- **Transportation:** Department of Transportation
- **Private-Sector Support:** Department of Homeland Security
- **Logistics:** Department of Homeland Security

Use Case Description

Name:

Disaster preparedness, disaster planning, emergency response, and community recovery/redevelopment.

Description

This Master Use Case brings together several use cases that 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 FOUO) of all Federal, State, Local, and Tribal government entities.
- A Situational Awareness System is in place and is deployed and/or deployable with all elements of the command and coordination hierarchy.

- Advanced location determination technology is deployed with emergency response personnel and apparatus.
- A wildfire event is occurring that threatens life and property in the dry southwestern region of the United States.
- Others TBD

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.

Appendix D: Geospatial Activity Examples for FEA BRM Lines of Business

NOTE: This table is a very preliminary draft and has not been vetted by the BRM Team.

Business Area	Lines of Business	Whether Geospatial Data or Services is a Primary or Secondary Element—Line of Business Description	Examples 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 Assessment of and planning for areas of vulnerability Conduct response operations. Tracking potential suspects 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 Conduct assessments of threat Integrating information from multiple sources 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 Planning troop operations and movements Determine optimal logistics supply routes Monitor opposition forces Provide assistance to civilian populations to minimize risk from threats.
Services for	International Affairs	Primary - the non-military activities that promote U.S. policies	Identify factors contributing to conflict

Citizens	and Commerce	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	and seeking resolution, Identifying areas with need for foreign economic development assistance Address social/ political development priority needs in regions of the world. Maintain knowledge of borders of nations and of trans-boundary issues. Assessing natural resource and/or economic conditions which might impact negotiation of treaties 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 Tracking distribution/location of evacuees Targeting and setting priorities for monitoring and response activities Status of infrastructure operations Providing an overview of damage to natural and manmade entities. Routing for the dispatch of emergency vehicles for emergency response 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	Crime tracking Pattern-based Crime prediction (e.g.

		emergency calls, as well as arrests, raids, and seizures of property.	analysis of the relationship between newly developed transportation corridors and increases in crime rate).Deployment of enforcement resources to maximize effectiveness 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 Geographically displaying and analyzing school performance, trends, and corrective actions taken Tracking of resources by district Tailoring programs based on demographics Determine boundaries for schools 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 Overview of location of natural resources such as coal, oil, and natural gas deposits. Determination of transportation facilities such as power line, pipelines and railroads Determination of impacts of energy operations and risks due to natural events such as weather

			Tracking of materials, both hazardous and nontoxic Tracking release and dispersion of fissile material and radioactive material 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 Determining levels of pollutants release from a hazardous materials spill and predicting impacts upon humans as well plant and animal species Predicting future air quality levels for transportation corridors based on differing emission standards Setting priorities for, monitoring, permitting, inspections, compliance assurance activities, enforcement etc. Designing monitoring networks Characterizing populations around hazardous release sites and/or stacks/outfalls and to protect potentially sensitive sub populations Monitoring environmental restoration and clean up
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	Monitoring emergent infectious diseases or outbreaks of disease and their spread

		the monitoring and tracking of public health indicators for the detection of trends and identification of widespread illnesses/diseases	Planning for the distribution of vaccines to meet needs of aging or young populations Determining the distribution of medical personnel in an area to meet the needs of populations Planning for the location of medical facilities to take advantage of transportation routes 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 Planning and managing timber production and economic effects on nearby communities. Assessing the biological health of wildlife populations and developing management plans for species which may be at risk Collecting and maintaining basic mapping data for use in all government and services programs Conducting seeding, replanting or other rehabilitation actions after wild land fires Analyzing and defining areas suitable for development and others more suitable for conservation
Services for Citizens	Community and Social Services	Primary—information about location for activities aimed at creating, expanding, or improving community and social	Planning the level of social services which are needed by communities

		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.	Determining underserved communities and providing facilities and services to meet needs Monitoring impact of programs on the health or educational achievement of communities Identifying locations in need of after school facilities 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 Planning for and stimulating the recovery of business affected by natural disasters Developing a picture of the flow of commerce domestically and its economic effects 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 fo different geographic areas of the nation Coordinating research activities to share results 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. Identifying areas prone to inmate violence in institutional settings Assigning probation and parole officers by geographic location; Directing probationers and parolees to services and treatment centers; Identifying Patterns of offenders and targeting efforts to high-risk areas, 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 Tracking and enforcing land use controls by red-flagging properties that have residual contamination after cleanup. Mapping the physical situation on the ground immediately after a spill or the air after a release to prove liability 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 includes all benefit programs, hat promote these goals for members of the public	Targeting programs to benefit the poor – households (income generation, health, housing, and sanitation) Estimating extent of poverty in a regions / Mapping where the poor live

			and/or regions with less potential for economic development to help target resource allocation Planning and targeting infrastructure programs Analyzing the spatial relationships between the providers' infrastructures/ public service centers and the clients' locations to help optimize the delivery of services Providing detailed demographic and business information for strategic planning 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 Analyze clusters of jobs and workers Determining if a proposed public transportation will connect workers to jobs Targeting recruitment efforts Designing facilities /work spaces to optimize worker needs
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

			Planning for long term infrastructure development and/or short term projects (e.g. Which potholes to fill next). Identify highway deficiencies and applies economic criteria to select the most cost-effective mix of highway system improvements. Summarizing freight movement trends in the U.S. 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 Tracking the implementation of public laws Assessing public support for proposed legislation over regions, states, districts etc. 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 Assessment of level of chemicals in waterways, air etc to determine need for regulation 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. Informing local and state legislators Ensuring environmental justice Providing the public access to information about their neighborhoods Communicating about natural/manmade disasters Summarizing alternatives in public meetings Providing travelers to public sites ability to plot their course for visits 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 Planning for deployment of emergency assistance resources Identification of the crew in closest proximity to a new, urgent work site for optimal dispatching. Tracking distribution of grants and contracts, and assets
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

			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 Targeting areas for preventive activities Managing deployment of resources to mitigate risks. 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. Targeting compliance and/or enforcement actions 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 , Managing facilities and properties Tracking real estate transactions that take place Gathering organizing and analyzing information on properties
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	Tracking and allocation of grants and/or contract dollars by state, congressional districts etc and assessing against goals.

		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	
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. Tracking the distribution of workers throughout an organization's various facilities /locations Comparing regional economic conditions when determining salaries to support raises and compensation packages Assessments of demographics to assess deployment and/or redeployment of employees 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 Providing information on public utilities supporting government facilities.
Management of Government Resources	Information and Technology Management	Secondary—involves the coordination of information and technology resources and systems required to support or provide a service	Identifying facility/personnel locations in planning network/bandwidth leasing
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.

			Assessing purchase patterns for future procurement Maintaining inventories

Appendix E: 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. 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.)

Geospatial Term	Type	Definition/Description
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.

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

		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.

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, 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 agencyapplications 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

		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

		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 Aviation (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,

		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

		(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 coordiante 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, which is 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.

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

		(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

		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		
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 pictoral 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.

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, like 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.

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.

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. 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

		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.

Mitigation Plan	Data	The scheme designed to minimize and alleviate riks, 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

		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, like 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).

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.

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.

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.

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 like 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.

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.

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 like 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

		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).

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.

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. 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.

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).

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

		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 F: Geospatial Service Components

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
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 Rollup/Rolldown (GDRR) Operations.	BC
Back Office Services	Data Management	Extraction and Transformation	Defines the set of capabilities that support the manipulation and change of	Feature Update Service	An application and supporting services for selection, browsing, extraction, transformation,	BC

Domain			data.		integration and update of a feature database. Assures that requestor credentials are sufficient 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 Domain	Data Management	Geographic Data Management (GIS) 15	A general-purpose set of capabilities for extracting, loading, transforming, integrating, storing, archiving and managing geospatial information and related metadata.	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. 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
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, coordinate transformation and linear referencing.	DC
Back Office Services Domain	Data Management	Imagery Data Management (GIS) 16	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"	BCS

[15] A complex Business Component System such as a GIS, featured here, does not fit neatly under the FEA SRM taxonomy [2]. 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.

[16] Likewise, a complex Business Component System such as an Imagery Processing System (IPS), featured here, does not fit neatly under the FEA SRM taxonomy [2]. 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.

					that conveys Geospatial Information in raster image form. It is used widely in government, education and business. 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.	
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) [17]	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. 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
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	Analysis and Statistics	Geographic Analysis (GIS)	A general-purpose set of capabilities for analyzing and processing geospatial	Geocoder/ Reverse	Able to determine geospatial coordinates, given an address (Geocoder), or determine address,	DC

[17] A complex Business Component System such as a GIS, featured here, does not fit neatly under the FEA SRM taxonomy [2]. 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.

Services Domain			data.	Geocoder Service	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.	
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 Analytical Services Domain	Analysis and Statistics	Geographic Analysis (GIS)	A general-purpose set of capabilities for analyzing and processing geospatial data.	Gateway Service	Determines the geospatial position of a known 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.	DC
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	DC

					realm.	
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 Services Domain	Analysis and Statistics	Geographic Analysis (GIS)	A general-purpose set of capabilities for analyzing and processing geospatial data.	Model Service	Able to determine and access the extent and nature of a geospatial model (e.g., Toxic Dispersion Model -- plume for a chemical or biological event in air or water). The model output is characterized by features. "Toxic Dispersion" refers to the effects of introducing a chemical, radioactive or biological agent into the atmosphere or a water supply at a point source. Simulation is employed to understand the effects of a toxic agent within its medium. The objective of the simulation is to ascertain contamination levels in a geospatial-temporal context, and thus, to understand the nature of toxic plumes, danger	DC

					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 Services Domain	Analysis and Statistics	Geographic Analysis (GIS)	A general-purpose set of capabilities for analyzing and processing geospatial data.	Sensor Planning Service	A service by which a client18 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.	DC
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

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

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,	DC

					and point features.	
Business Analytical Services Domain	Analysis and Statistics	Imagery Analysis (IPS)19	A general-purpose set of capabilities for analyzing and processing 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. 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
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	BC

[19] Likewise, a complex Business Component System such as an Imagery Processing System (IPS), featured here, does not fit neatly under the FEA SRM taxonomy [2]. 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.

					reports, alert/warning reports, incident reports, activity reports, etc.	
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.	Coverage Client*	An application that provides the means to visualize and interact with Coverages (e.g., 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.	BC20
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, GPS21	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.	BC22
Business Analytical	Visualization	Mapping, geospatial (GIS),	Provide for the representation of position information through the use of	Situation Awareness	An application and associated services for viewing an area of interest, incident or event in a	BC

[20] 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.

[21] 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."

[22] 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.

Services Domain		elevation, GPS	attributes such as elevation, latitude, and longitude coordinates		geospatial context. May include related geospatial services for selection, analysis, manipulation, reporting, collaboration, etc.	
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	Coverage Client*	An application that provides the means to visualize and interact with Coverages (e.g., 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.	BC23
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.	BC24
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	BC25

[23] 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.

[24] 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.

					associated with one or more geospatial data 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	Specialized Geospatial Business Components (Various)	Geospatial-based business applications and 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.	BC26
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).	BC27
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.	BC28
Business	Visualization	Mapping,	Provide for the representation of	Style	The means to create, update and manage styles	BC

[25] 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.

[26] 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.

[27] 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.

[28] 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.

Analytical Services Domain		geospatial (GIS), elevation, GPS	position information through the use of attributes such as elevation, latitude, and longitude coordinates	Management Service (SMS)	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".	
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 a proximity). Provides the means to visualize point of interest information. Provides tools to query point of	BC

					interest data and display chosen view, often on a map. Normally implemented as wireless, Location-based Services (LBS).	
Digital Asset Services Domain	Content Management	Map Production (GIS) 29	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. 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) 30	A general-purpose set of capabilities for authoring, publishing and sharing softcopy and hardcopy geospatial	Imagery Processing System (IPS)*	An integrated system for collecting, storing, accessing, sharing, disseminating, integrating, manipulating, visualizing, analyzing and otherwise	BCS

[29] A complex Business Component System such as a GIS, featured here, does not fit neatly under the FEA SRM taxonomy [2]. 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.

[30] Likewise, a complex Business Component System such as an Imagery Processing System (IPS), featured here, does not fit neatly under the FEA SRM taxonomy [2]. 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.

			imagery data.		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. 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.	
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	Knowledge	Information	Defines the set of capabilities that	Terrain Server	The means to render 3D views of geospatial data.	DC

Services Domain	Management	Sharing	support the use of documents and data in a multi-user environment for use by an organization and its stakeholders.		Responds to requests from a Terrain Simulator to deliver a rendered 3D data. Supports coordinate transformation from a source coordinate 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* (aka 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 G: Geospatial Standards Profile

Source	Document Code	Specification Title	Version	Description
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 datastore 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 [2].
OGC	WMC	Web Map	1.1	A companion specification to the OGC Web Map Service Interface Implementation

		Context Documents		Specification version 1.1.1 [4], 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
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	SML	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	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 [4], 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	http://www.fgdc.gov/metadata/contstan.html
FGDC	FGDC-STD-001.1-1999	Content Standard for Digital Geospatial Metadata, Part 1: Biological Data Profile		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		http://www.fgdc.gov/standards/status/csdgm_rs_ex.html
FGDC	FGDC-STD-001.2-2001	Metadata Profile for Shoreline Data		http://www.fgdc.gov/standards/status/sub5_6.html
FGDC	FGDC-STD-002	Spatial Data Transfer Standard (SDTS)		http://mcmcweb.er.usgs.gov/sdts/ (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		http://www.fgdc.gov/standards/status/sub4_1.html

		and Extensions		
FGDC	FGDC-STD-002.6	SDTS Part 6: Point Profile		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		http://www.fgdc.gov/standards/status/sub3_2.html
FGDC	FGDC-STD-003	Cadastral Data Content Standard		http://www.fgdc.gov/standards/status/sub3_5.html
FGDC	FGDC-STD-004	Classification of Wetlands and Deepwater Habitats of the United States		http://www.fgdc.gov/standards/status/sub3_4.html
FGDC	FGDC-STD-005	Vegetation Classification Standard		http://www.fgdc.gov/standards/status/sub2_1.html
FGDC	FGDC-STD-006	Soil Geographic Data Standard		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		http://www.fgdc.gov/standards/status/sub1_1.html
FGDC	FGDC-	Content		http://www.fgdc.gov/standards/status/sub3_6.html

	STD-008-1999	Standard for Digital Orthoimagery		
FGDC	FGDC-STD-009-1999	Content Standard for Remote Sensing Swath Data		http://www.fgdc.gov/standards/status/sub4_4.html
FGDC	FGDC-STD-010-2000	Utilities Data Content Standard		http://www.fgdc.gov/standards/status/sub3_1.html
FGDC	FGDC-STD-011-2001	U.S. National Grid		http://www.fgdc.gov/standards/status/usng.html
ISO	13249-3:2003	Information technology -- Database languages -- SQL multimedia and application packages -- Part 3: Spatial		
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		
ISO	19101-2	Geographic information -- Reference model -- Part 2: Imagery		
ISO	19103	Geographic information -- Conceptual schema language		
ISO	19104	Geographic information -- Terminology		

ISO	19105:2000	Geographic Information - Conformance and testing		
ISO	19106:2004	Geographic Information - Profiles		
ISO	19107:2003	Geographic Information - Spatial schema		
ISO	19108:2002	Geographic Information - Temporal Schema		
ISO	19109:2005	Geographic Information - Rules for application schema		
ISO	19110:2005	Geographic Information - Methodology for feature cataloguing		
ISO	19111:2003	Geographic Information - Spatial referencing by coordinates		

ISO	19112:2003	Geographic Information - Spatial referencing by geographic identifiers		
ISO	19113:2002	Geographic Information - Quality Principles		
ISO	19114:2003	Geographic Information - Quality evaluation procedures		
ISO	19115:2003	Geographic Information - Metadata		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	19115-2	Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data		
ISO	19116:2004	Geographic Information - Positioning services		
ISO	19117:2005	Geographic Information - Portrayal		

ISO	19118	Geographic Information - Encoding		
ISO	19119:2005	Geographic Information - Services		
ISO	19120:2001	Geographic information -- Functional standards		
ISO	19121:2000	Geographic information -- Imagery and gridded data		
ISO	19123	Geographic Information - Schema for coverage geometry and functions		
ISO	19125-1:2005	Geographic Information - Simple feature access -- Part 1: Common architecture		
ISO	19125-2:2004	Geographic Information - Simple feature access -- Part 2: SQL option		

ISO	19127:2005	Geographic information -- Geodetic codes and parameters		
ISO	19128	Geographic information -- Web Map Server interface		
ISO	19130	Geographic information -- Sensor and data models for imagery and gridded data		
ISO	19131	Geographic information -- Data product specification		
ISO	19132	Geographic information -- Reference model -- Location based services framework		
ISO	19133	Geographic information -- Location-based services -- Tracking and navigation		

ISO	19134	Geographic information -- Location based services -- Multimodal routing and navigation		
ISO	19135	Geographic information -- Procedures for item registration		
ISO	19136	Geographic information -- Geography Markup Language		
ISO	19137	Geographic information -- Generally used profiles of the spatial schema and of similar important other schemas		
ISO	19138	Geographic information -- Data quality measures		
ISO	19139	Geographic information -- Metadata --		

		XML schema implementation		
ISO	19141	Geographic information -- Schema for moving features		
ISO	19142	Geographic Information - Web Feature Service		
ISO	19143	Geographic Information - Filter encoding		
ISO	6709:1983	Standard representation of latitude, longitude and altitude for geographic point locations		
ANSI	320-1998 (R2003)	Information technology - Spatial Data Transfer		
ANSI	353-2004	Information Technology - Geographical Information Systems - Spatial Data Standard for		

		Facilities, Infrastructure, and Environment (SDSFIE)		
ANSI	61-1986 (R2002)	Geographic Point Locations for Information Interchange, Representation of (formerly ANSI X3.61-1986 (R1997))		
INCITS	BSR INCITS PN-1574-D-200x	Information technology - Geographic Information Framework Data Content Standards		
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. http://www.remotesensing.org/geotiff/geotiff.html

Appendix H: Excerpts from U.S. Federal Law and Policy

This appendix contains some relevant excerpts from U.S. Federal Law and Policy.

U.S. Federal Law

The purposes of Section 216 [31] of the E-Government Act (Common Protocols for Geographic Information Systems) are to: "reduce redundant data collection and information; and promote collaboration and use of standards for government geographic information."

In Section 216, the term `geographic information' means information systems that involve locational data, such as maps or other geospatial information resources." [32]

Section 216 assigns responsibilities for "the development of common protocols for the development, acquisition, maintenance, distribution, and application of geographic information".

The Federal Geographic Data Committee (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".

Section 216 states: "The common protocols shall be designed to:

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

(2) promote the development of interoperable geographic information systems technologies 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."

U.S. Federal Policy

OMB Circular A-16 [33] "establishes a coordinated approach to electronically develop the National Spatial Data Infrastructure" (NSDI).

The NSDI is described as "the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data." (In Circular A-16: "Spatial data refers to information about places or geography, and has traditionally been shown on maps." [2])

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[31] 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:

[32] 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.

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

Interoperability is a key focus of Circular A-16:

"The NSDI assures that spatial data from multiple sources (federal, state, local, and tribal governments, academia, and the private sector) are available and easily integrated to enhance the understanding of our physical and cultural world."

Among the components of the NSDI are standards, metadata, and the National Spatial Data Clearinghouse.

"NSDI is made possible by the universal use of standards and protocols for data development, documentation, exchange, and geospatial services. [...] NSDI standards are developed and promulgated by the FGDC in accordance with OMB Circular A-119 using an established process determined by the FGDC with input from a broad range of data users and providers. [...] To broaden the global use of federal data and services, international standards and protocols must be used."

Circular A-16 states that reliable metadata, structured in a standardized manner, facilitates search for, access to, and use of geospatial data or services.

Circular A-16 addresses the requirement for a National Spatial Data Clearinghouse acting as an electronic service for access to documented spatial data and metadata from distributed data sources.

Circular A-16 mandates that "agencies will provide or develop the required technology and services required to enable and provide access to NSDI data and information." Accordingly, Circular A-16 "provides direction for federal agencies that produce, maintain or use spatial data either directly or indirectly".

Circular A-16 directs agencies, "both internally and through their activities involving partners, grants, and contracts" to:

"(1) Prepare, maintain, publish, and implement a strategy for advancing geographic information and related spatial data activities appropriate to their mission, in support of the NSDI Strategy. [...]

"(2) Collect, maintain, disseminate, and preserve spatial information such that the resulting data, information, or products can be readily shared with other federal agencies and non-federal users, and promote data integration between all sources. [...]

"(4) Use FGDC data standards, FGDC Content Standards for Digital Geospatial Metadata, and other appropriate standards, documenting spatial data with the relevant metadata, and making metadata available online through a registered NSDI-compatible Clearinghouse node.

"(5) 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, building upon local data wherever possible.

"(6) Use spatial information to enhance electronic government initiatives, to make federal spatial information and services more useful to citizens, to enhance operations, to support decisionmaking, and to enhance reporting to the public and to the Congress. [...]

"(10) Search all sources, including the National Spatial Data Clearinghouse, to determine if existing federal, state, local or private data meets agency needs before expending funds for data collection. [...]"

Appendix I: Acronym List

NOTE: The following acronyms are incomplete and come (mostly) from Appendix E.

Acronym	Definition
ADA	Americans with Disabilities Act of 1990
AOI	Area of Interest
AVL	Automatic Vehicle Locator
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
CATS	Consequences Assessment Tool Set
COI	Community of Interest
COP	Common Operating Picture
CWA	Clean Water Act
DBMS	Database Management System
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
DFO	Disaster Field Office
DTM	Digital Terrain Model
EA	Enterprise Architecture
ESRI	Environmental Systems Research Institute
FAA	Federal Aviation Administration
GDR	Geospatial Data Rollup
GIF	Graphics Interchange Format
GIS	Geographic Information System
GIT	Geospatial Information Technology
GML	Geography Markup Language
GMO	Geospatial Management Office
GPS	Global Positioning System
HEC2	Hydrologic Engineering Center 2
HVAC	Heating, Ventilation & Air Conditioning
ICS	Image Catalog Service
INS	Inertial Navigation System

InSAR	Interferometric Synthetic Aperture Radar
IPS	Image Processing System
JPEG	Joint Photographic Expert Group
LBS	Location-Based Service
LiDAR	Light Detection and Ranging
LOF	Location Organizer Folder
LORAN	Long Range Radio Aid to Navigation
MSOP	Mission-Specific Operating Picture
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NOAA	National Oceanic & Atmospheric Administration
NOV	Notice of Violation
OGC	Open GIS Consortium
OSHA	Occupational Safety and Health Act of 1970
PDA	Personal Digital Assistant
PDD	Presidential Decision Directive
PNG	Portable Network Graphics
PNT	Positioning Navigation Targeting
POI	Point of Interest
RFID	Radio Frequency Identification Device
SAR	Synthetic Aperture Radar
SBP	Semantic Business Profiles
SCADA	Supervisory Control and Data Acquisition
SDP	Semantic Data Profiles
SMS	Style Management Service
SQL	Structured Query Language
SSP	Semantic Service Profiles
TIFF	Tagged Image File Format
TNM	The National Map
URI	Uniform Resource Identifier
USGS	US Coast Guard
USGS	U.S. Geological Survey
USOP	User-Specific Operating Picture
WCS	Web Coverage Service

WFS	Web Feature Service
WGS	World Geodetic System
WMS	Web Map Service
WRS	Web Registry Service
WTS	Web Terrain Server
XIMA	Image and Map Annotation
XML	Extensible Markup Language

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