HOMELAND SECURITY GEOSPATIAL ENTERPRISE ARCHITECTURE

GEOSPATIAL MANAGEMENT OFFICE

DRAFT VERSION 0.6.1

June, 2004

CONTENTS

EXHIBITS

1.0 INTRODUCTION

The Department of Homeland Security (DHS) is establishing the Baseline ('As-Is') and Target ('To-Be') Homeland Security (HLS) Enterprise Architecture (EA), the Transition Strategy for migrating from Baseline to Target EA, and the Governance Strategy for incremental implementation of the Target HLS EA. The Target HLS EA is conceptual in nature and was developed following a "top-down, business-driven" process, thereby making it fully supportive of the mission and business objectives of the Department, and the broader HLS community.

Version 1.0 of the Final Target EA Description, dated August 29, 2003, has been characterized as "a mile wide and an inch deep". This version of the EA, called the Geospatial Enterprise Architecture (GEA), adds a dimension of depth by elaborating on the role of geospatial data and technology in HLS. It is an extension of the Target EA, not a separate EA. The GEA provides further detail on the nature of HLS business, data, applications and technology, and the context for how geospatial capabilities permeate the Target HLS EA.

To carry out its mission and meet strategic objectives, DHS and the broader HLS community must operate in a fully 'location-enabled' environment. Therefore, it is crucial for the geospatial context of the HLS enterprise to be fully represented and integrated within the HLS EA. [The geospatial context was not fully represented in version 1.0 of the Final Target EA Description, dated August 29, 2003.]

1.1 Purpose

This document describes the role of geospatial data and technology in the HLS EA, heretofore referred to as the HLS GEA. The HLS GEA:

- Provides an integrated view of the geospatial context across all facets of the HLS EA;
- Presents recommendations for extending the HLS EA to address the role of geospatial data and technology;
- Stands alone as a model for integrating the geospatial technology across DHS and the broader HLS Community
- Provides a baseline for governing geospatial technology insertions.

1.2 Audience

This document is oriented to the following audiences:

- DHS component policy-makers, planners, architects, and developers involved in location-based business activities;
- Anyone involved in the broader HLS mission, including state, local, tribal, and private sector, that has a need for geospatial information technology; and
- The Federal EA community.

1.3 Updates

This version of the HLS GEA is the fourth draft. The first draft provided initial recommendations for extending the geospatial context of the EA as viewed by DHS Geospatial

Management Office (GMO) staff. This version elaborates on those recommendations and provides a set of EA artifacts that define the geospatial capabilities envisioned for the Target EA. It is also worthy to note that this version was the result of an Interagency GEA Task force made up of participants from:

- DHS GMO
- United States Geological Survey (USGS)
- National Geospatial-Intelligence Agency (NGA)
- United States Northern Command (NORTHCOM)
- Open GIS Consortium (OGC)

This document will be updated as the HLS EA evolves; and as additional information is made available within DHS and from other sources.

1.4 HLS Enterprise Architecture Framework

The HLS Target EA provides the enterprise with an architecture vision of where DHS and the broader HLS community intend to be at some point in the future. This starts with a description of the business value chains and activities, as represented in a business model. Regarding the data and applications architecture, the Target EA defines the major kinds of data, applications and components needed to support HLS business activities. The Target EA Technical Architecture defines the technology components, patterns and platforms needed to support the HLS applications. The HLS Target EA is described in the following artifacts:

- Business Model
- Conceptual Data Model
- Notional Application Architecture
- Notional Component Architecture
- Technology Architecture
- Application Technology Drivers
- Mapping of Technology Patterns to Components

1.5 Document Organization

The HLS GEA leverages the HLS EA framework to provide a set of geospatial business, data, technology and domain specific artifacts. This document summarizes and references that set of artifacts as follows.

Exhibit 1: Document Organization

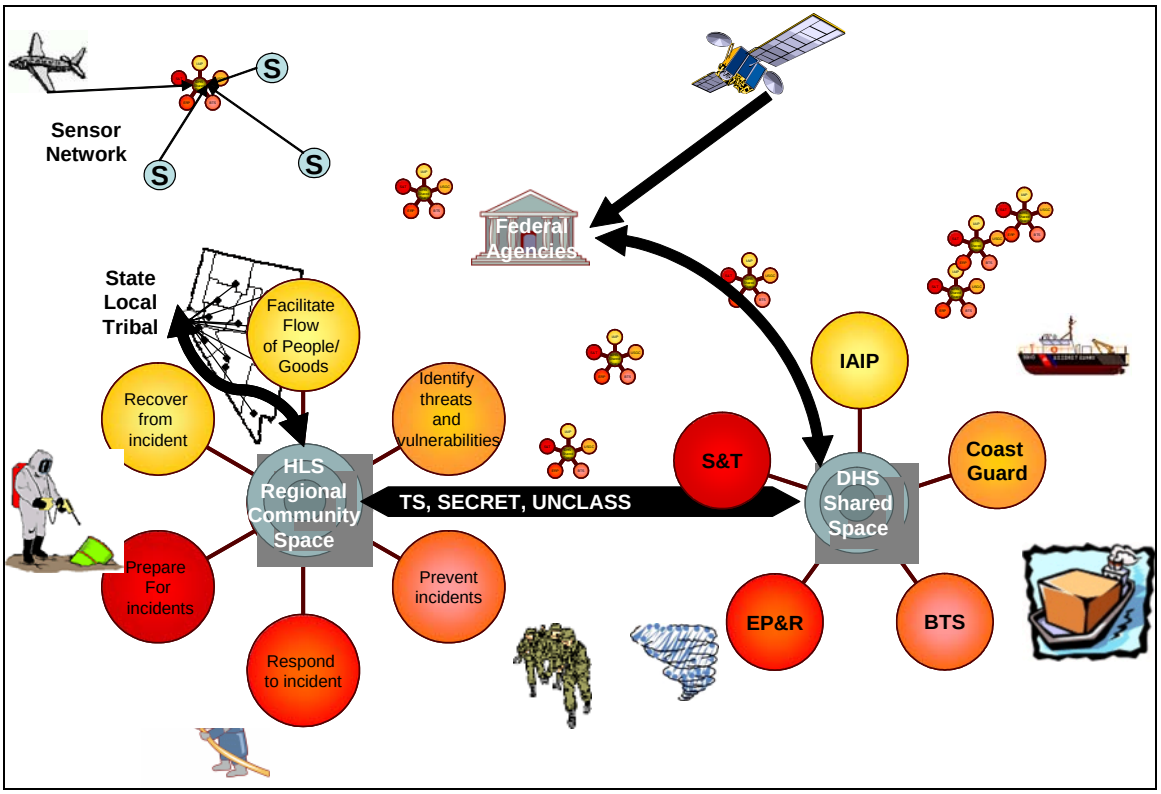
Section	Purpose
Section 1 Introduction	Describes the purpose of this document, intended audiences, and plans for updates

Section 2 HLS Geospatial Concept of Operations	Describes the key operational aspects of the HLS GEA
Section 3 Geospatial Business Context	Describes the business and mission aspects of the HLS GEA
Section 4 Data and Information Architecture	Describes the data and information aspects of the HLS GEA
Section 5 Geospatial Application and Component Architecture	Describes the service, component, and application aspects of the HLS GEA
Section 6 Geospatial Technical Architecture	Describes the technical aspects of the HLS GEA
Acronyms	Defines acronyms used in this document
List of References	Identifies referenced sources in addition to the references to standards that are included within individual sections

2.0 HLS GEOSPATIAL CONCEPT OF OPERATIONS

At present, the contributions of geospatial data and technology are implicit in the HLS Geospatial Concept of Operations (Exhibit 2), which employs a map of the United States to convey the scope of operations. In its current form, the HLS Geospatial Concept of Operations provides a conceptual depiction of HLS geospatial operations developed using mission-based business scenarios. Its primary purpose is to provide a visual depiction of the high-level operations of the Department in order to convey the broad scope of HLS geospatial operations. The following sections describe key aspects of the HLS GEA Concept of Operations.

Exhibit 2: HLS Geospatial Concept of Operations



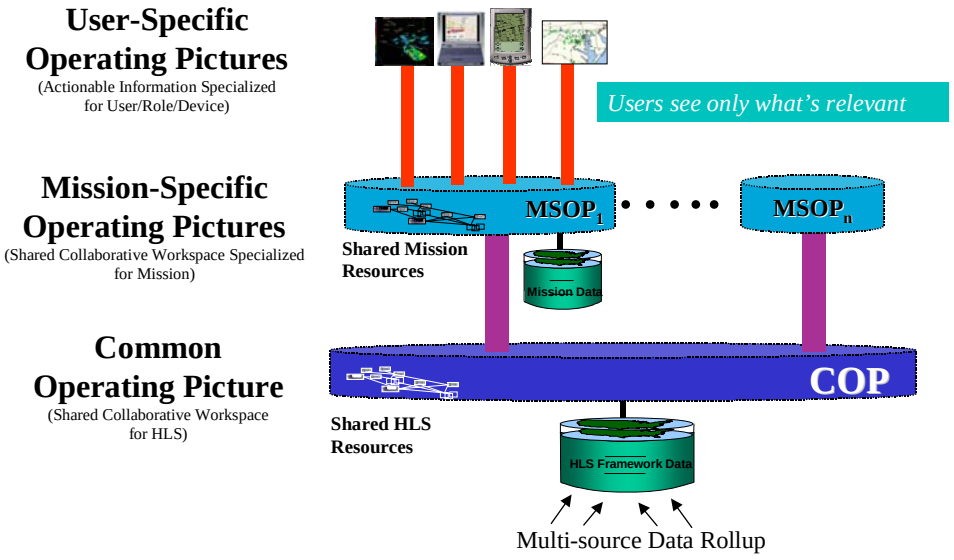
2.1 Location: A Fundamental Concept in HLS Operations

(Geospatial) Location is a foundational property for modeling and understanding HLS business activities and is a ubiquitous information ingredient in the HLS mission. Location can be exploited as a unifying information theme to better understand the context of most real and abstract phenomena associated with HLS. Location, in its simplest form, can be used to depict where something is on the earth. It is contextually simple and intuitive to most people, and it is the way people commonly understand and relate to the world around them. Location provides a common semantic-business framework upon which HLS activities are conducted. The HLS GEA exploits the value of location throughout the enterprise, providing its value wherever and whenever it is needed.

2.2 Common Operating Picture

The COP is a collection of time-sensitive, mission-critical, shared data and services (i.e., set of capabilities) associated with an area of interest that conveys geospatial situational context (a composite of HLS Framework Data and HLS Auxiliary Data), the disposition and behaviors of threat(s), friendly personnel and assets, as well as incidents, events, observations, related intelligence and other HLS operations data. A COP represents a collaborative workspace for interoperations between distributed stakeholders in support of time-sensitive, mission-critical HLS operations. The COP is not merely a common data view, rather it consists of many possible views generated on-the-fly based upon relevant services, available data, and application context. [Note: Direct viewing of the COP is not practical due to the overwhelming quantity and detail of the composite HLS Framework Data. Thus, the more practical, coherent MSOP and USOP.]

Exhibit 3: Shared Resources and Operating Pictures



2.3 Mission-Specific Operating Picture

A Mission-Specific Operating Picture (MSOP) is a collaborative workspace (data and services), which exists for a specific mission. The MSOP is a collaborative workspace comprised of the subset of shared COP resources that are required for a mission, integrated with other shared, collaborative mission-specific resources. The MSOP is effectively a filtered portal to the COP that integrates mission-specific resources. Thus, there are many MSOPs, at least one for each DHS component mission, but perhaps several for a mission.

2.4 User-Specific Operating Picture

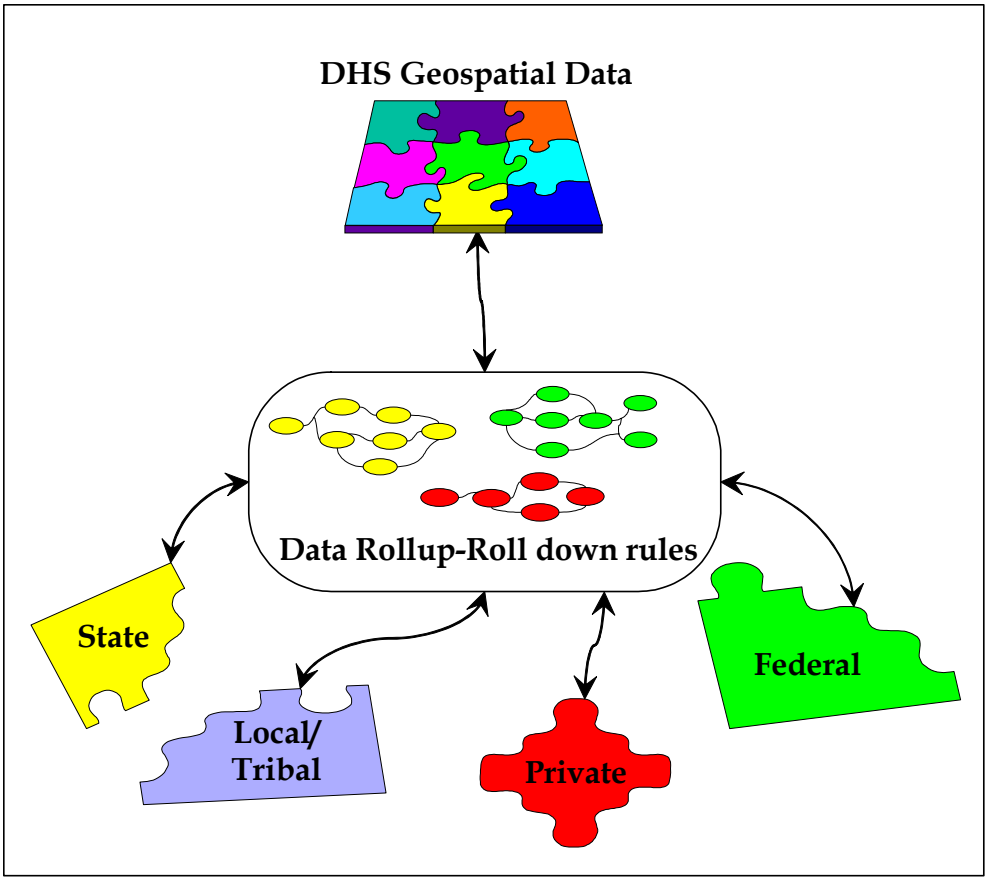
A User-Specific Operating Picture (USOP) is a specialized, actionable view of a shared collaborative COP/MSOPs, which is created for a specific user. The USOP is effectively a filtered portal to the COP/MSOPs, through which a user in a specific role, on a specific mission/task, and using a specific device, views the COP/MSOPs. Thus, there are many USOPs (views) of the COP/MSOPs.

2.5 Geospatial Data Rollup and Roll down Operations

The greatest challenge of creating the COP for the HLS mission is the provision of mission relevant, current, accurate, time-sensitive geospatial information. This challenge is magnified by the fact that much of the high-value information is created and owned by state, local, tribal, private, federal entities and must be rolled-up to form the COP (see Exhibit 4). The converse of this may also hold true, where the most timely and accurate information exists at the federal level, in which case it needs to be rolled down to the MSOP. A Geospatial Data Rollup/down (GDR) process is critical to responding to these challenges. Following are the specific technical issues that must be addressed to enable rollup/down operations.

- An Essential Model for HLS Framework Data must be established to ensure logical consistency and semantic interoperability. Geospatial data modeling to support the HLS GEA is discussed in Section 4, Geospatial Data Architecture
- Catalogs must be employed for registering, publishing and sharing information about geospatial metadata, data and associated geospatial enterprise services, including the semantic meaning, schema, structure, and access protocols; and
- Standards-based geospatial data access and other required geospatial enterprise services with well-known semantics must be employed to support GDR operations

Exhibit 4: Geospatial Data Rollup/down



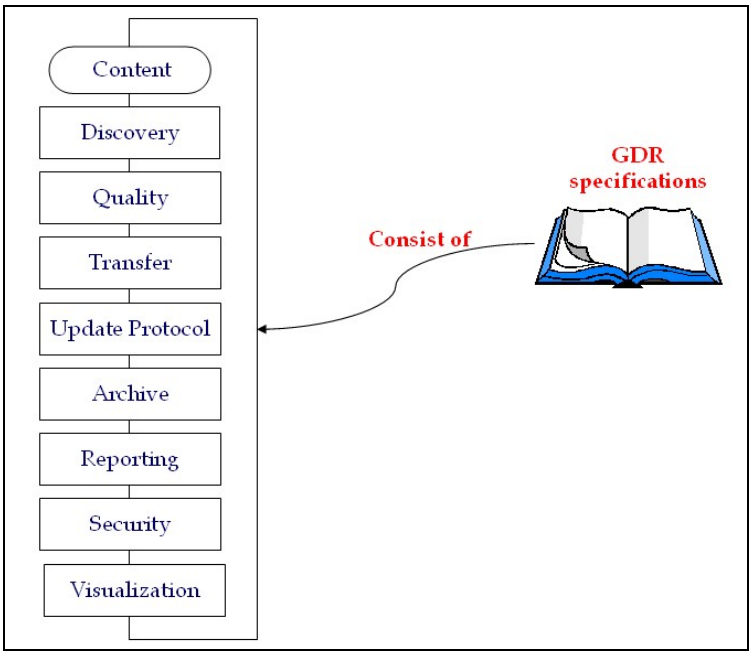
The GDR Concept of Operations (CONOPS) serves as a roadmap for defining policies, procedures, and detailed implementation specifications for required components to accomplish GDR and create the geospatial data required for HLS. Local, Tribal, State, and Federal data providers will use this CONOPS and the required specifications to plan and engage in developing GDR components, policies, and procedures to support seamless, automated data rollup/down. Private sector providers, with relevant content, will use this CONOPS to plan and engage in developing GDR components that will handle HLS and private sector interactions. This includes, but is not limited to, copyrights and pricing.

2.5.1 Conceptual View

This section provides a top-level description of the Geospatial Interoperability Framework (set of interoperability specifications) required in support of GDR (Exhibit 5):

- Data Content & GDR Operations Specifications: Contains detailed description of the Essential Model for HLS Framework Data. The GDR Operations Specification contains a detailed description of operations to rollup/down and translate data from data providers/stewards to HLS databases.
- Discovery Specifications: Contains detailed description of the mandatory and optional metadata elements. All HLS Framework Data must meet the minimum metadata requirements defined by the GEA. These specifications also contain taxonomies of HLS Framework Data types to assist in data discovery. (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).)
- Quality Specifications: Prescribe the minimum quality parameters of the data that providers must meet before they can publish their data as HLS Framework Data. Quality information is defined in the metadata for that particular dataset. It is expected that each framework data theme (e.g., routing) will have its own specific quality specifications.
- Transfer Specifications: Defines the structure and semantics for data exchange between providers and HLS. These are expected to be Geography Markup Language (GML) application schemas. It is expected that each HLS Framework Data class will have its own application schema.
- Update Protocol Specifications: Geospatial data change in varying frequencies. For example, Road Network data do not change frequently, while weather data can change frequently during the day. Update Protocol Specifications define the means to synchronize between HLS databases and providers of these data sources. They also define appropriate technologies to achieve this task, and include alert, notification, and update mechanisms.
- Archiving and Mirroring Specifications: HLS Framework Data is a critical cornerstone of the HLS mission. GDR must ensure data availability at all times to support critical HLS tasks. These specifications define the essential guidelines and protocols to ensure automated periodic archiving and data replication involving redundant/backup enterprise nodes.
- Reporting Specifications: Defines technologies and protocols to enable periodic and on-demand reporting about HLS Framework Data contents and GDR operations status.
- Geosecurity Specifications: Defines technologies for secure exchange of sensitive geospatial content across the Internet (e.g., public/private keys). It also defines authentication and authorization (credentials) technologies to access HLS Framework Data.
- Visualization Specifications: Provide predefined specifications to view geospatial data differently depending on the role of HLS user (symbolization standards). It also defines the appropriate technologies to visualize the data.

Exhibit 5: Required GDR Specifications

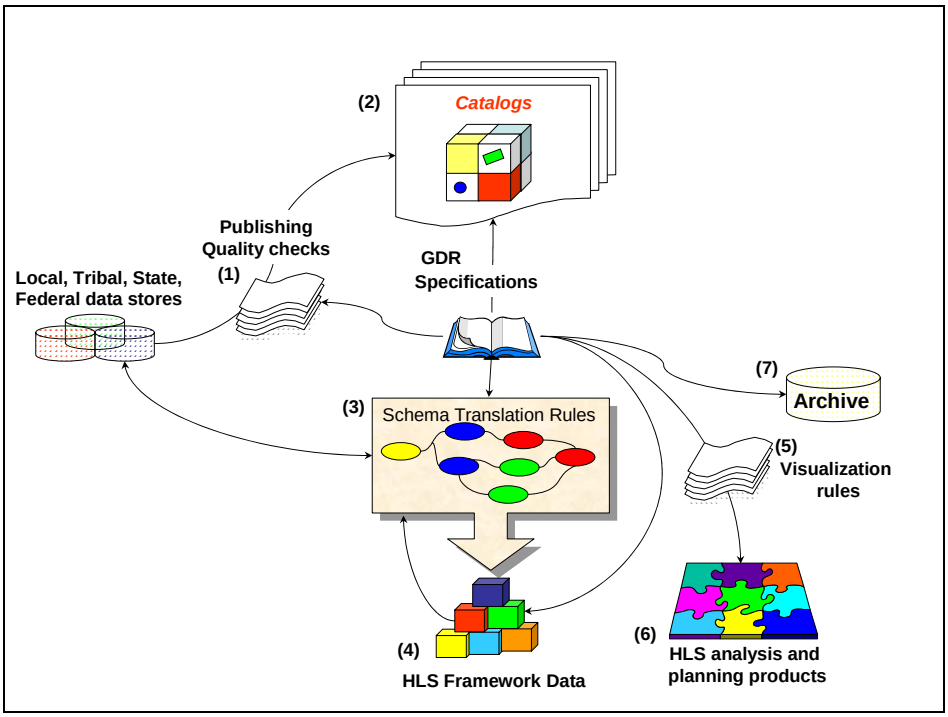


2.5.2 GDR Operational Environment

Exhibit 6 shows the CONOPS for GDR. HLS Framework Data and GDR specifications provide the blue print for implementing GDR:

1. Data providers/stewards must pass interoperability compliance tests before publishing their data and participating in GDR
2. Data sets must be published on the Master HLS Framework Data Catalog
3. Data must be translated to the required, standard schemas defined by DHS (Schema should be flexible and easily translatable through standard interfaces and protocols)
4. Data can either be stored locally at HLS system nodes or retrieved on-demand from remote servers. Access to data must be provided by Digital Rights Management Services (DRM)
5. Users must be able to access geospatial symbol sets and styles depending on their needs. They must also be able to dynamically render geospatial data for visualization using appropriate rules, depending on user roles, device and mission/tasks
6. Users must be able to use geospatial data to perform planning, analysis, management and other operational tasks
7. To ensure quick recovery in case of emergency, geospatial data must be archived (and replicated) according to HLS Framework Data and GDR specifications

Exhibit 6: Concept of Operations for Geospatial Data Rollup/down



3.0 GEOSPATIAL BUSINESS CONTEXT

3.1 Geospatial Business Language: Key Terms

A *Geospatial Business Language* is defined to describe the key concepts (ontology) for the role of geospatial business processes, data and technology within the HLS enterprise (See Attachment G_Bus_1_Geospatial_Business_Language_Key_Terms). These definitions form the basis for a consistent business language, a lingua franca for describing the role of geospatial in HLS Business Activities. It embodies the geospatial semantics for the HLS mission. Further, these terms are used to construct the *Geospatial Business Statements*, which describe the role of geospatial for each of the HLS Business Activities.

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.)

3.2 Geospatial Business Activities

The role of geospatial data (location) and geospatial technology in the HLS mission is defined in terms of *Geospatial Business Statements*. These statements are based upon the *Geospatial Business Language*. Most HLS Business Activities have one or more such statements that describe the primary uses of geospatial data and technology, and also defines the main Geospatial Applications (and application components) involved in the HLS enterprise. Many of the applications include non-geospatial data and technology, and may be predominantly non-geospatial in nature. As such, the value of geospatial service components is crucial to many HLS Business Activities. HLS applications will need authorized access to these components when and where they are needed in the HLS enterprise.

Attachment_G_Bus_2_Geospatial_Business_Activities maps HLS Business Activities to HLS Geospatial Roles, where each role is expressed in terms of *Geospatial Business Statements* and Geospatial Applications. Some *Geospatial Business Statements* are broad capabilities that apply across the entire enterprise, while others may only apply to specific activities that are unique to a particular business area. For example, the first HLS Business Activity, HLS007, lists several *Geospatial Business Statements* that apply across the enterprise. These broadly relevant applications are only listed under the first activity and are not repeated for the other activities in which they apply. On the other hand, a number of more specialized *Geospatial Business Statements* and Geospatial Applications are repeated for several business activities. This is done where necessary to emphasize specialization, and to demonstrate commonality between HLS Business Activities.

Finally, it is important to note that many Geospatial Applications will have several specialized implementations. For example, it is unlikely that there will be a single Mission Planning application. Rather, the complexity and diversity of mission operations necessitates the need for specialization and diversity of mission planning business processes and sub-processes. However, there will be a number of common geospatial service components and data upon which all Mission Planning applications will depend.

4.0 GEOSPATIAL DATA ARCHITECTURE

An Essential Model for geospatial-temporal data is required in order to effectively and efficiently benefit from geospatial-temporal context throughout the HLS enterprise. It is critical to achieving interoperability. The Essential Model for GEA consists of: 1) common, standard Geospatial Entity Types, the base models for representing geospatial data within GEA, 2) Geospatial Elements and Properties, which are the common, standard elements-properties for expressing location reference information in all HLS business data, and 3) a Geospatial Data Dictionary, which contains the authoritative standard definitions for all geospatial data classes used in the HLS mission. This version of the GEA defines an initial framework for these components of the Essential Model.

Version 1.0 of the HLS EA Conceptual Data Model includes a Subject Area named Location, which contains the Data Objects: Physical Location and Virtual Location. In order to extend the HLS EA Conceptual Data Model, the GEA Team replaced the Physical Location Data Object with Geospatial Entity to more fully describe this category of objects. The descriptions of these key terms are provided in Exhibit 7 and Exhibit 8.

Exhibit 7: HLS EA Subject Areas Directly Related to Geospatial Data

Subject Area	Description
Location	Details about geospatial and/or virtual location. Includes, but not limited to, information about navigable waters, air, bridges, icebergs, cyberspace, etc. [Taken from the Target EA.]

Exhibit 8: HLS EA Data Objects Relating to Geospatial Data

Subject Areas	Data Objects	Description
Location	Geospatial Entity	Root Data Object for HLS geospatial data that are used in Geospatial Enterprise Services and other geospatial components. Decomposed into the following types: Location Object, Feature, Coverage, Observation, Route, Mobile Object and Structure
Location	Virtual Location	Cyberspace address, e-mail, web site address (URL), TCP/IP address

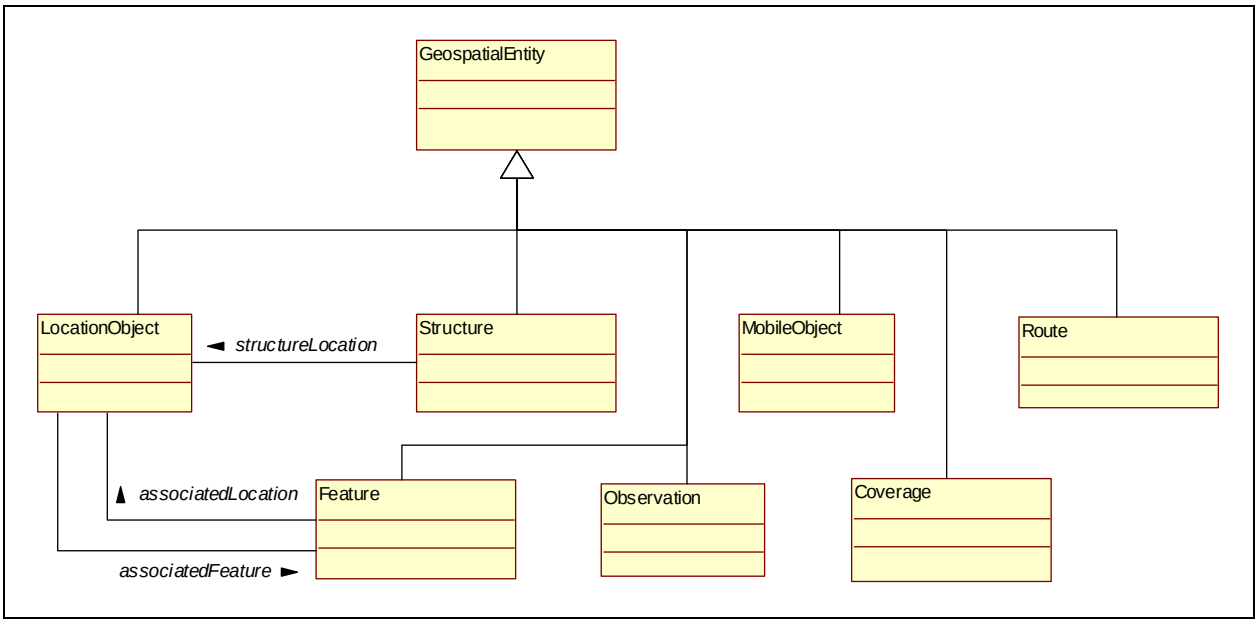
The Virtual Location Data Object is not described in this version of the HLS GEA.

4.1 Geospatial Entity Types

Geospatial Entity Types represent the foundational geospatial data objects (models) for representing geospatial data within the HLS Geospatial Interoperability Framework (i.e., the primary representation of geospatial content in network messages, and the representation of geospatial types within request-response parameters comprising geospatial service interfaces).

A Geospatial Entity represents a large domain of geospatial data and a wide range of uses. The Geospatial Entity is used to identify a location on the Earth or a model of any real-world phenomena, and contain location representations that support transformations between geospatial reference systems. A Geospatial Entity is decomposed into seven objects: Location Object, Feature, Coverage, Mobile Object, Observation, Route, and Structure. The hierarchy of the Geospatial Entity is illustrated in Exhibit 9, Geospatial Entity Types.

Exhibit 9: Geospatial Entity Types



A description of each Type follows:

- The Location Object describes a site or place in a normalized structure suitable for data interchange.
- A Feature describes real-world phenomena in a geospatial context. It may have an associated Location Object (or the Location Object may be associated with the Feature) to support transformation between the two representations for the same real-world entity. Other classes also describe real-world phenomena, but the Feature is typically used for immobile phenomena or those that are slow to move or change.
- A Structure describes a building or other structure in a more detailed 3D context with references to its geospatial location.
- An Observation associates an observed or measured value with the geospatial-temporal context of the observation.
- A Mobile Object describes dynamic real-world phenomena that change position or state relatively rapidly (e.g., person, conveyance, etc).
- A Coverage associates a set of discrete values with a geospatial area.
- A Route describes a path between locations.

A detailed description of each of the Geospatial Entity Types can be found in Attachment_G_Data_1_Geospatial_Entities. Subsequent versions of this artifact will elaborate on these types and identify the associated standards for implementing these types. All Geospatial Entity Types will be based upon industry standards.

4.2 Geospatial Properties and Elements

A number of common geospatial data elements and properties have been defined for the HLS EA to support the widespread exploitation of geospatial data. These elements and properties are the building blocks for defining Geospatial Entity Types, as well as any location reference data associated with non-geospatial data (e.g., an address in an INS record). They must be standardized to achieve geospatial interoperability.

Attachment_G_Data_2_Geospatial_Properties_Elements, lists the data geospatial elements and properties that can be utilized by all data objects within the HLS EA, including Geospatial Entity Types and predominantly non-geospatial data objects, thus providing a normalized geospatial context for all HLS Data Objects.

Consistent use of these elements-properties throughout the HLS EA will enhance interoperability and the use of standard Geospatial Enterprise Services that exploit these elements-properties. For example, by using common elements-properties for the specification of an address, any HLS business data that includes an address can be exploited and shared between systems and jurisdictions.

4.3 Geospatial Data Dictionary

The Geospatial Data Dictionary (Attachment_G_Data_3_Geospatial_Data_Dictionary) defines the primary classes of geospatial data for the HLS GEA. There are two top-level super-classes of geospatial data associated with the HLS mission: HLS Framework Data and HLS Auxiliary Data. HLS Framework Data consists of the geospatial data classes that are required for the HLS mission. It includes classes that are created by active participants in the mission, as well as those created by supporting data providers/stewards. HLS Auxiliary Data consists of any geospatial data classes that are not required for the HLS mission but may be used in the mission.

The dictionary employs a simple three-tier data classification scheme for HLS Framework Data. The three tiers consist of Category (data class), Sub-Category (data subclass), and Type. The data dictionary lists all major data categories and sub-categories. Although many data types are listed in the geospatial definitions, they are not defined in full and require elaboration by data providers/stewards of the data.

5.0 GEOSPATIAL APPLICATIONS

The analysis of the HLS business led to the definition of several Geospatial Applications and Application Components for HLS GEA (Exhibit 10). Many of these applications/application components include non-geospatial data and technology, and may be predominantly non-geospatial in nature. Many Geospatial Applications will have several specialized implementations. For example, it is highly unlikely that there will be a single Mission Planning application. Rather, the complexity and diversity of mission operations necessitates the need for specialization and diversity of mission planning business processes and sub-processes. However, there will be a number of common Geospatial Enterprise Services and associated data upon which all Mission Planning applications will depend. A complete definition of each of the applications can be found in Attachment_G_App_1_Geospatial_Applications.

Exhibit 10: HLS Geospatial Applications & Application Components

Asset Inventory Management	Monitor Locations
Biographical Analysis	Monitor Parties
Case Analysis	Monitor Recovery
Common Operating Picture Manager	National Security Special Event Reporting
Countermeasure Planning	Operational Planning
Critical Infrastructure Inventory Management	Performance Planning & Analysis
Damage Assessment	Post Mission Analysis
Data Acquisition/ Generation	Preparation Planning
Data Collection Management	Program Planning
Data Collection Planning	Public Information Outreach
Disaster Assistance	Recovery Planning
Electronic Navigation	Response Planning
Emergency Reporting	Risk Analysis
Evacuation Planning & Management	Screening and Risk Analysis
Event Analysis	Search and Rescue Planning
Event Planning & Analysis	Search and Rescue Response
Exercise Planning	Security Planning
Facility Mapping & Management	Security Protection & Management
Geospatial Data Transfer	Sensor Management
Geospatial Integration & Test Tools	Site Analysis
Hazard Mapping	Situation Awareness
Health & Safety Monitoring	Suspicious Activity Reporting
Hydraulic-Hydrographic Modeling	Tariff Management
Incident/Event Management	Threat Analysis
Incident Reporting	Threat Consequence Assessment
Location Search & Reporting	Threat Detection
Logistics Planning	Training Exercise Simulation
Map Publication	Training Planning & Support
Mission Planning	Travel Planning
Mission Rehearsal	Vulnerability Analysis
Mitigation Planning & Analysis	Warning/Alert Management
Monitor Assets	Waterway Management
Monitor Conveyances	Weather Modeling & Analysis
Monitor Goods	

6.0 GEOSPATIAL TECHNICAL ARCHITECTURE

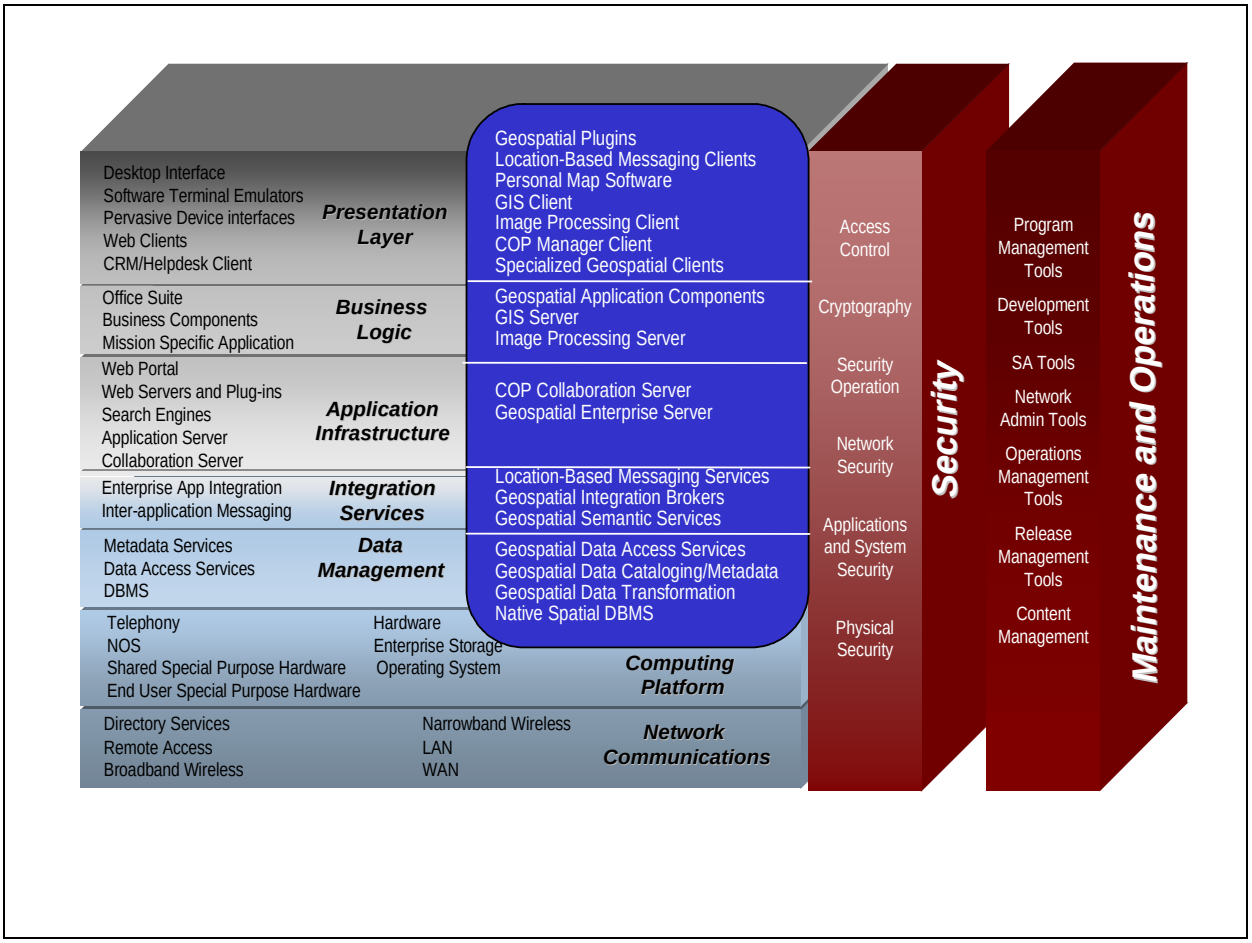
6.1 Geospatial Technical Reference Model

The HLS Technical Reference Model (TRM) provides a common conceptual framework that will assist in effectively and efficiently coordinating the acquisition, creation, development,

operation, and recapitalization of Information Technology (IT)-based systems within the HLS enterprise.

The GEA version of the TRM (Exhibit 11) emphasizes the role of Geospatial Information Technology (GIT) in the HLS Technical Architecture (see Attachment_G_Tech_1_Geospatial_Technical_Reference_Model). It extends version 1.0 of the DHS EA TRM (DTCGHS-03-A-FLC035-001-0009A, published August 29, 2003). The GEA version also reflects some recent enhancements to the DHS EA, which will appear in the next version of the TRM.

Exhibit 11: HLS GEA TRM



As illustrated in Exhibit 11, the main types of geospatial components in the layers of the TRM are:

- Presentation Layer
  - Geospatial Plug-ins
  - Location-based Messaging Clients
  - Personal Map Software
  - Specialized Geospatial Clients (67 types)

    - Geographic Information System (GIS) Clients
    - Image Processing Clients
    - Common Operating Picture (COP) Manager Client
- Business Logic Layer
    - Geospatial Application Components
    - GIS Server
    - Image Processing Server
- Application Infrastructure Layer
    - Geospatial Enterprise Server
    - COP Collaboration Server
- Data Interchange/Integration Layer
    - Location-Based Messaging Services
    - Geospatial Integration Brokers
    - Geospatial Semantic Services
- Data Management Layer
    - Geospatial Data Access Services
    - Geospatial Data Cataloging & Metadata Management Services
    - Geospatial Data Transformation Services
    - Native Spatial DBMS
- Computing Platform Layer
    - Position Determination Technology
    - Navigation Technology
    - Remote Sensing Hardware

6.2 Geospatial Components

The HLS GEA TRM presents the EA context for all geospatial technology components. Attachment_G_Tech_2_Geospatial_Components summarizes these components. The layers of the HLS TRM that have geospatial components are as follows:

- Presentation—the technical services required to create and present application interfaces to end users;
- Business Logic—application-specific logic representation;
- Application Infrastructure—the technical services required to allow business logic, and other application logic to function;

- Integration Services—the technical services and components required to interchange data among applications and services;
- Data Management—the technical services and components required to access and modify data of all types; and
- Computing Platform—physical hardware and operating system services that support the components of the TRM Service Framework.

6.3 Technology Patterns

The geospatial technology patterns that are commonly used throughout the HLS GEA are documented in Attachment_G_Tech_3_Geospatial_Technology_Patterns. The patterns included in this version of the GEA TRM are the primary patterns required to support GDR operations, which are needed to create the HLS COP. Additional patterns will be added in subsequent versions of the TRM.

The patterns involved in GDR are:

- Data Publishing Pattern - The function of this pattern is to enable data providers/stewards to publish their data and support HLS operations using tools to validate and verify compliance with GDR standards. The Publishing Pattern provides data validation and verification services. The services validate the published data against a well-defined application schema. The services also verify that the data quality parameters and currency are within acceptable ranges.
- Data Discovery Pattern - Catalog Services provide a common mechanism to classify, register, describe, search, maintain, and access information about available geospatial resources. These resources are network addressable instances of typed data or services. This pattern is designed to allow users/clients to search HLS geospatial databases based on data type, named location, and user-defined bounding areas. When multiple sources exist for a specific data type in an area of interest, users will be able to select among them, based on available metadata. Furthermore, when multiple sources exist for a specific data type in an area of interest, this pattern will automatically select one based on appropriate criteria and policies. Users may need to search for desired data by ‘drilling down’ multi-levels of metadata, from general to more specific data. Multi-level search can be based on HLS Framework Data hierarchy.
- Translation Pattern - The function of this pattern is to allow HLS users to obtain desired data for a particular area, without needing to know the details of how the data are stored and maintained. For example, DHS might maintain a service providing interstate highway data, a State might serve data about the highways under its jurisdiction, and a city might serve urban street data. An HLS user should be able to obtain and seamlessly manipulate these data, including roads from all of these jurisdictions simultaneously, letting the Translation Pattern automatically interact with the necessary services and integrate data as necessary to fulfill the request. Users can send a query based on standard schemas, and the Translation Service will have the task of translating the query to other schemas, as well as map the response back to the Target HLS application schema.

- Digital Rights Management (DRM) Pattern - In its broadest view, DRM is concerned with the management of all rights, not just digital rights. DRM technology was originally focused on the problem of persistent protection of digital content. Persistent protection mechanisms involve authentication, authorization and encryption technologies for locking digital contents and limiting distribution to those who pay. Protection is persistent when it remains in force wherever the content is in the enterprise. Today, DRM covers a much broader spectrum of capabilities and underlying technologies supporting description, identification, trading, protection, monitoring, and tracking of all forms of rights usages for geospatial data.
- Update and Synchronization Pattern - This pattern is designed to achieve three tasks, 1) Notify and alert HLS users of new updates to HLS Framework Data, 2) Poll service providers for new updates to specific data, and 3) Respond to update and synchronization requests sent by data providers/stewards. A Transactional Web Feature Service (WFS) and Web Coverage Service (WCS) provide an open, standard interface to manipulate and manage Features and Coverages, respectively. A standard notification and synchronization protocol is required for geospatial content.
- Visualization Pattern - A Catalog Service can be used to publish and register symbol libraries as well as customized symbolization and styling rules for use by other authorized users. These rules must used to generate standard HLS maps that depend on users' rolls and current tasks. A Web Map Service (WMS) and Coverage Portrayal Service provide interfaces to generate standard maps and coverages respectively. Client applications are required to provide symbol and style management as well as visualization.
- Data Access Pattern – This pattern provides a level of isolation between the data and the code that requires or manipulates it. It acts as an adaptor and allows data calls in the code to be standardized. In this manner, it exposes a simpler interface to the code. This allows the DA pattern to adapt to different storage schemas without affecting its clients (the components requiring data access). [This pattern is described in greater detail in the Target EA.] There is a specialized variation of this general pattern required for accessing geospatial data, the Geospatial Data Access Pattern, which includes the ability to handle spatial indexes and operators.
- Content Management Pattern – This pattern is used in solutions that assemble and manage data in support of HLS operations. There is a specialized variation of this general pattern required for managing geospatial data, the Geospatial Data Access Pattern, which includes the ability to handle spatial indexes and operators.

7.0 ACRONYMS

Acronym	Definition
BTS	Bureau of Transportation Statistics
CAC	Civil Applications Committee
CIA	Central Intelligence Agency

CONOPS	Concept of Operations
COP	Common Operating Picture
DBMS	Database Management System
DHS	Department of Homeland Security
DIA	Defense Intelligence Agency
DoD	Department of Defense
DOE	Department of Energy
DOS	Department of State
DRM	Digital Rights Management
EA	Enterprise Architecture
EP&R	Emergency Preparedness & Response
GDR	Geospatial Data Rollup
GEA	Geospatial Enterprise Architecture
GIT	Geospatial Information Technology
GML	Geography Markup Language
GMO	Geospatial Management Office
HLS	Homeland Security
HUMINT	Human Intelligence
IAIP	Information Analysis and Infrastructure Protection
IMINT	Imagery Intelligence
IT	Information Technology
LAN	Local Area Network
MASINT	Measurement and Signature Intelligence
MSOP	Mission-Specific Operating Picture
NASA	National Aeronautics & Space Administration
NGA	National Geospatial-Intelligence Agency
NOAA	National Oceanic & Atmospheric Administration
NORTHCOM	United States Northern Command
NOS	Network Operating System
NSA	National Security Agency

NTM	National Technical Means
S&T	Science & Technology
SIGINT	Signals Intelligence
TCP/IP	Transmission Control Protocol/Internet Protocol
TNM	The National Map
TRM	Technical Reference Model
TTIC	Terrorist Threat Integration Center
URL	Uniform Resource Locator
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WAN	Wide Area Network
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Map Service

8.0 ATTACHMENTS

Attachment Name	File Name
Attachment G Bus 1: Geospatial Business Language Key Terms	Attachment_G_Bus_1_Geospatial_Business_Language_Key_Terms.doc
Attachment G Bus 2: Geospatial Business Activity	Attachment_G_Bus_2_Geospatial_Business_Activity.doc
Attachment G Data 1: Geospatial Entities	Attachment_G_Data_1_Geospatial_Entities.doc
Attachment G Data 2: Geospatial Properties - Elements	Attachment_G_Data_2_Geospatial_ Properties-Elements
Attachment G Data 3: Geospatial Data-Dictionary	Attachment_G_Data_3_Geospatial_ Data_ Dictionary
Attachment G App 1: Geospatial Applications	Attachment_G_App_1_Geospatial_ Applications.doc
Attachment G Tech 1: Geospatial Technical Reference Model	Attachment_G_Tech_1_Geospatial_Technical_Reference_Model.doc
Attachment G Tech 2: Geospatial Components	Attachment_G_Tech_2_Geospatial_Components.doc
Attachment G Tech 3: Geospatial Technology Patterns	Attachment_G_Tech_3_Geospatial_Technology_Patterns.doc

9.0 REFERENCES

[i] DHS architecture: It's a wrap, Federal Computer Week, Oct. 13, 2003

[ii] Homeland Security Enterprise Architecture Compendium and Transition Strategy, Version 1

[iii] GIS: Infrastructure Underpinnings for the National Map, Dangermond and Brown, PE&RS, Volume 69, Number 10, October 2003