HOMELAND SECURITY GEOSPATIAL ENTERPRISE ARCHITECTURE

ATTACHMENT G TECH 3
GEOSPATIAL TECHNOLOGY PATTERNS

GEOSPATIAL MANAGEMENT OFFICE

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CONTENTS

EXHIBITS

1.0 INTRODUCTION

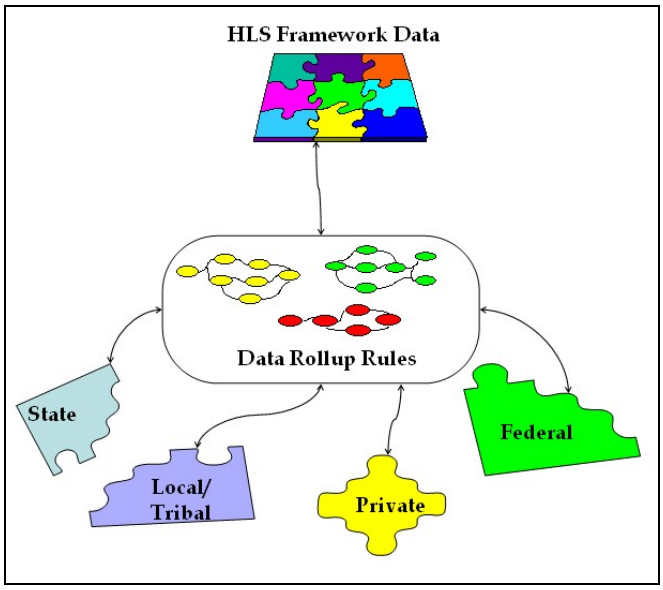
The geospatial technology patterns that are commonly used throughout the Homeland Security (HLS) Geospatial Enterprise Architecture (GEA) are documented herein. The patterns included in this version of the GEA Technical Reference Model (TRM) are the primary patterns required to support Geospatial Data Rollup (GDR) operations, which are needed to create the HLS Common Operating Picture (COP). Additional patterns will be added in subsequent versions of the TRM.

1.1 Geospatial Data Rollup Operations

The greatest challenge of creating the COP for the HLS mission is the provision of mission appropriate, current, accurate, time-sensitive geospatial information. This challenge is magnified because 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 1). A GDR process is critical in responding to this challenge. Following are some specific technical issues that must be addressed to enable geospatial rollup operations.[i]

- An Essential Model for *HLS Framework Data* must be established to ensure logical consistency and semantic interoperability (currently underway). [Consists of well-known HLS Geospatial Entity Types, Elements, Properties, Data Dictionary.]
- 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 geospatial enterprise services with well-known semantics must be employed to support GDR.

Exhibit 1 HLS GEA Stakeholders



This 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 service providers will use this CONOPS and the required specifications to plan and engage in developing GDR components, policies and procedures to support data exchange in an interoperable environment. 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.

The following patterns support GDR.

1.1.1 Data Publishing Pattern

The Problem

HLS requires geospatial data that must meet predefined quality standards. Geospatial data can either be stored locally in a central database cluster at HLS or stored at the service provider's sites. In either case, technologies are required to enable automated data verification and publishing. Therefore, data must be described in standard metadata templates. Data also must meet minimum quality and currency specifications. The massive amount of data available to support HLS management, planning and analysis operations must be checked for their compliance with the specifications. Automated approaches are required to perform compliance tests before data are accepted for publishing.

The Solution

The function of this pattern is to enable data providers/stewards to publish their data, and to 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.

Application of the Pattern

The logical application of this pattern includes

- Standard metadata schema based on Federal Geographic Data Committee (FGDC) and International Standards for Organizations (ISO) 19115 standards.
- Standard Application Schema based on Geospatial Markup Language (GML).
- Well-defined test suite to indicate the compliance of the data set with respect to HLS standards.
- Tools to harvest metadata automatically of and automatically execute the test suites. If the data set passes the test, it is then published using a catalog service, which is based on OGC Catalog Service Specifications.
- Client Application to enable the functionalities mentioned above.

1.1.2 Data Discovery Pattern

The Problem

HLS Framework Data is a network of distributed databases designed to support HLS tasks. Users require single entry point to allow them to locate relevant data quickly. Users need seamless access to *HLS Framework Data* to search and select from available data.

The Solution

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 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 specific data. Multi-level search can be based *HLS Framework Data* hierarchy.

Application of the Pattern

The logical application of this pattern includes

- Standard metadata schema based on FGDC and ISO 19115 standards
- Hierarchical structure of the metadata that correspond to the level of details of data from Local/Tribal, State, and Federal service providers
- OpenGIS Catalog Service Specifications will enables seamless discovery of data
- Client Application to enable the functionalities mentioned above
- Taxonomy of feature types to enable intelligent search. For example, users can enter keywords for a feature type, e.g., Road, and the catalog returns information about highways, access roads, streets, etc.

1.1.3 Translation Pattern

The Problem

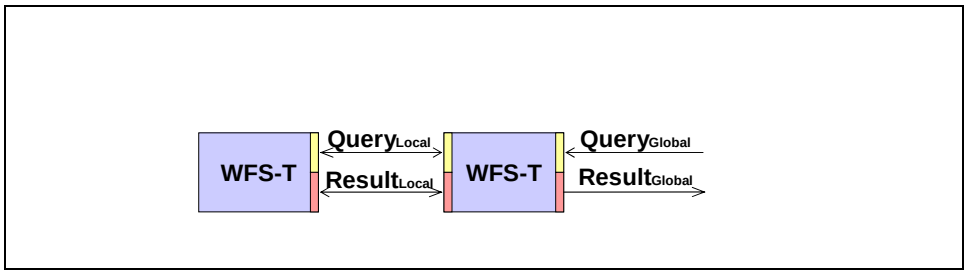
HLS is able to access geospatial data from a variety of providers distributed across the network. These providers can have their data based on different schemas. It is rather impossible for HLS users to use these heterogeneous data to perform time critical tasks. A technology is required to seamlessly translate service providers' application schemas to HLS application schemas.

The Solution

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 by independent organizations. For example, Department of Homeland Security (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. A 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 combine data as necessary to fulfill the request. As shown in Exhibit 2, users can send a Query based on schemas that they understand and the Translation Service will have the task of translating the query to other schemas and map the response back to the target HLS application schema.

Exhibit 2 Schema Translation Pattern



Application of the Pattern

Schema translation is an adaptation of an existing OGC web service, the Web Feature Service (WFS), with the goal of integrating distributed data in this way. The WFS-X enables the providers of the local data, who are exactly the ones to best know how their data fits into the Standard Application Schema, to be provided by HLS, to perform the task of mapping their data into the well-defined schema. The provider's standard application schemas are defined in GML. The logical application of this pattern includes:

- Standard application schemas provided by HLS
- Catalog that contains registered standard application schemas, service providers' application schemas as well as their mapping rules. This will enable automated service discovery and translation
- Transactional Web Feature Service (WFS-T), which enables seamless access to geospatial data

1.1.4 Digital Rights Pattern

The Problem

Real-time up-to-date access to data is critical to achieve HLS mission. A new paradigm is required to provide real-time access to data that change frequently, e.g., Weather data. Furthermore, private sector service providers in the United States hold geospatial content that will play an important role in HLS management, planning, and analysis tasks. While this is generally a good thing, many private enterprises involved in the production and trading of geospatial data with the federal government and HLS in particular will find the need to protect their intellectual property assets through the digital distribution value chain. Organizations want to specify, manage, control and track geospatial data distribution within safe, open and trusted environments. A system of operating agreements and interoperable technologies are needed to enable broader distribution and use of geospatial data while protecting the rights of producers and users.

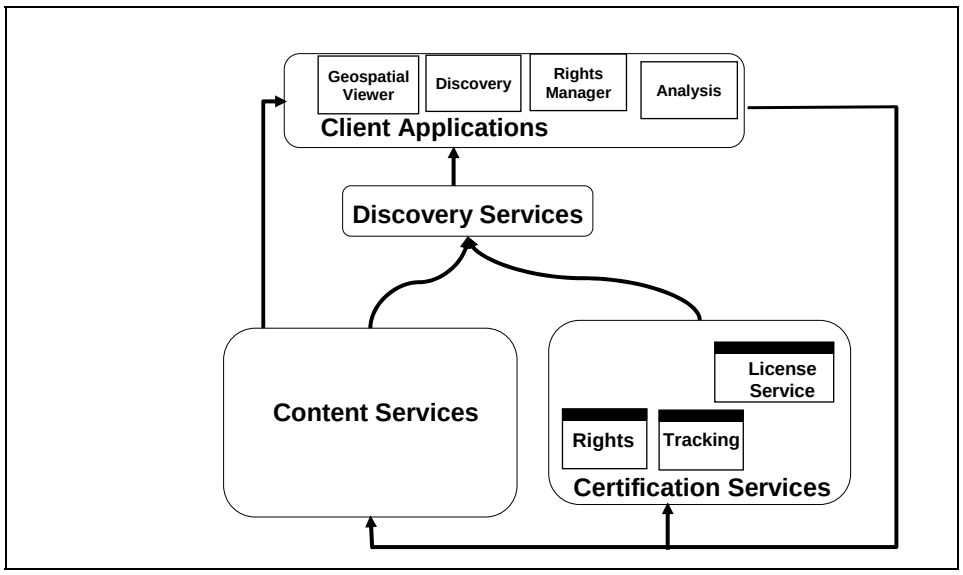
The Solution

Digital Rights Management (DRM) in its broadest view is concerned with the management of all rights, not just digital rights. DRM technology was originally focused on the narrow problem of persistent protection of digital content. Persistent protection mechanisms involve authentication, authorization and encryption technologies for effectively 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.

Application of the Pattern

The core concept in DRM is the use of digital licenses. Instead of buying the digital content, the consumer Purchases a license granting certain rights with respect to the content. A license is a digital data file that specifies certain usage rules for the digital content. Usage rules can be defined by a range of criteria, such as frequency of access, expiration date, restriction of transfer to other devices, printing permission, copy permission etc. These rules can be combined to enforce certain business models, such as rental or subscription, try-before-buy, pay-per-use, etc.

Exhibit 3 Roll of DRM



As shown in Exhibit 3, DRM consists of the following components

- Rights Service: This service binds the geospatial data elements (data set, features, and attributes) with the access rights. The service is dedicated mainly to the definition and redistribution of rights between users of the system as the result of a transaction. This service also enables users to search and view available rights for each data element. eXtensible rights Markup Language (XrML) is a digital rights language used to specify rights, terms, and conditions. Using XrML, anyone owning or distributing digital resources (content, services, or software applications) can identify the parties allowed to

use those resources, the rights available to those parties, and the terms and conditions under which those rights may be exercised.

- Licensing Service: This service is to enable online licensing mechanisms. It enables the creation and distribution of electronic certificates for content providers, discovery service providers, and HLS user. The service creates and distributes encrypted licenses (sometimes called tickets permits, or vouchers) that describe rights to content, the identities of the users or devices to whom the rights are granted, and the conditions (e.g., payments) under which they are granted. It is also possible to include license description in the packaged data, in case online licensing is not required. Using Licensing Service, Content providers can develop different licensing schemes based on duration limitation, time limit, number of uses, or pay per use.
- Tracking service: The Tracking Service is responsible for logging license consumptions and transactions for every user. For instance, in an online licensing model, a user might only be allowed to print a document twice. The Tracking Service can keep a counter of the number of times a user printed the document. This service must be tight to the Distributor Service so that the appropriate charging is applied.

1.1.5 Update and Synchronization Pattern

The Problem

In a large distributed information system like HLS EA, data must be kept up-to-date at all times. Automated update and synchronization is essential to maintain data currency and integrity.

The Solution

This pattern is design 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
3) Respond to update and synchronization requests sent by data providers/stewards

The OpenGIS Transactional 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.

Application of the Pattern

The logical application of this pattern includes:

- Work in conjunction with Data Publishing Pattern to automatically verify and test the data for their completeness and compliance with the standard
- Work in conjunction with Schema Translation to map data from application schemas of service providers to standard application schemas of HLS
- Protocol to support polling and synchronization of geospatial content based on some predefined spatial and temporal parameters, e.g., bounding box, time and location.

1.1.6 Visualization Pattern

The Problem

The HLS user community consists of a widely varied set of individuals and roles that have different visualization requirements. A mechanism is required to publish and share symbolizing and stylizing rules.

The Solution

The OpenGIS 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. The OpenGIS 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.

Application of the Pattern

The logical application of this pattern includes:

- Catalog Service to register symbols and styles
- Catalog service to register user-defined stylizing and symbolizing rules. This including registering the OpenGIS Styled Layer Descriptors (SLD).
- Mechanism to dynamically bind symbols and styles according to users' rolls and tasks
- Client applications to manage and create symbol and style libraries and rules
- Client applications to generate visualizations based on symbols and styles

2.0 ACRONYMS

Acronym	Definition
CONOPS	Concept of Operations
COP	Common Operating Picture
DHS	Department of Homeland Security
DRM	Digital Rights Management
FGDC	Federal Geographic Data Committee
GDR	Geospatial Data Rollup
GEA	Geospatial Enterprise Architecture
GML	Geographic Markup Language
HLS	Homeland Security
ISO	International Standards for Organizations

OGC	Open GIS Consortium
SLD	Styled Layer Descriptors
TRM	Technical Reference Model
WFS	Web Feature Service
WFS-T	Transactional Web Feature Service
WMS	Web Map Service
XrML	eXtensible rights Markup Language

3.0 LIST OF REFERENCES

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