HOMELAND SECURITY GEOSPATIAL ENTERPRISE ARCHITECTURE

ATTACHMENT G DATA 1
GEOSPATIAL ENTITIES

GEOSPATIAL MANAGEMENT OFFICE

DRAFT VERSION 0.6.1

April 13, 2004

CONTENTS

EXHIBITS

1.0 INTRODUCTION

This artifact documents the basic Geospatial Entity Types for Homeland Security (HLS) Geospatial Data. These types represent the foundational geospatial data objects (models) for representing geospatial data within the HLS 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). The data models for these types are described herein. 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).

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 1 and Exhibit 2.

Exhibit 1: 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.**

Exhibit 2: HLS EA Data Objects Relating to Geospatial Data

Subject Areas	Data Objects	Description
Location	Geospatial Entity	Root data type for HLS geospatial data that are used in geospatial services. Decomposed into Location Object, Feature, Coverage, Observation, Route, Mobile Object and Structure.
Location	**Virtual Location**	**Cyberspace address, e-mail, web site address (URL), TCP/IP address**

For this version of the HLS GEA, the Virtual Location Data Object is not considered.

1.1 Geospatial Data Elements and Properties in the Enterprise

A number of common geospatial data elements and properties have been defined for the HLS EA to support the efficient and widespread exploitation of this data. The HLS Geospatial Properties-Elements, Appendix G.Data.2, lists data elements and properties that can be utilized by all data objects within the HLS EA, including geospatial and predominantly non-geospatial objects, thus providing a normalized geospatial context for all objects.

Consistent use of these properties and elements throughout the HLS EA will enhance interoperability and the use of standard geospatial enterprise services that exploit these properties and elements. For example, by using a common semantic framework for the specification of an

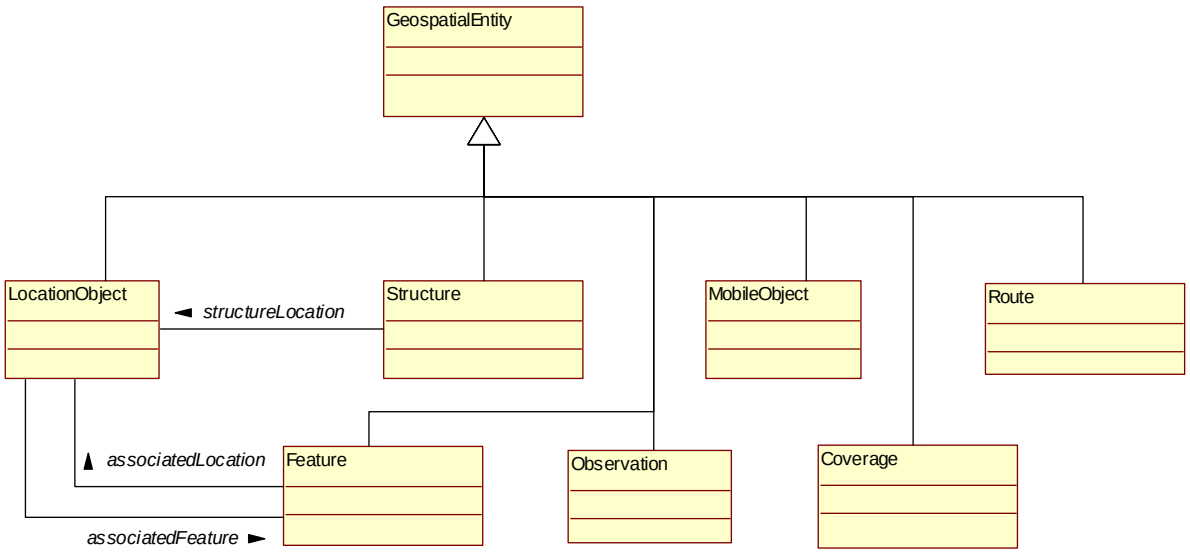
address, any HLS business data that includes the address can be more easily exploited and shared between systems and jurisdictions.

The Geospatial Entities described below contain the elements and properties described in Appendix G.Data.2. The elements and properties provide the key building blocks for the data objects comprising the GEA. The description below provides the relationships and structure of these data objects, which, as elements and properties, can be integrated into the EA to support the combination of geospatial and other business data to support viewing of HLS business data in a geospatial context.

2.0 GEOSPATIAL ENTITY DESCRIPTION

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, model real-world phenomena, and contain location representations that support transformations between 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 3.

Exhibit 3: Geospatial Entity Types



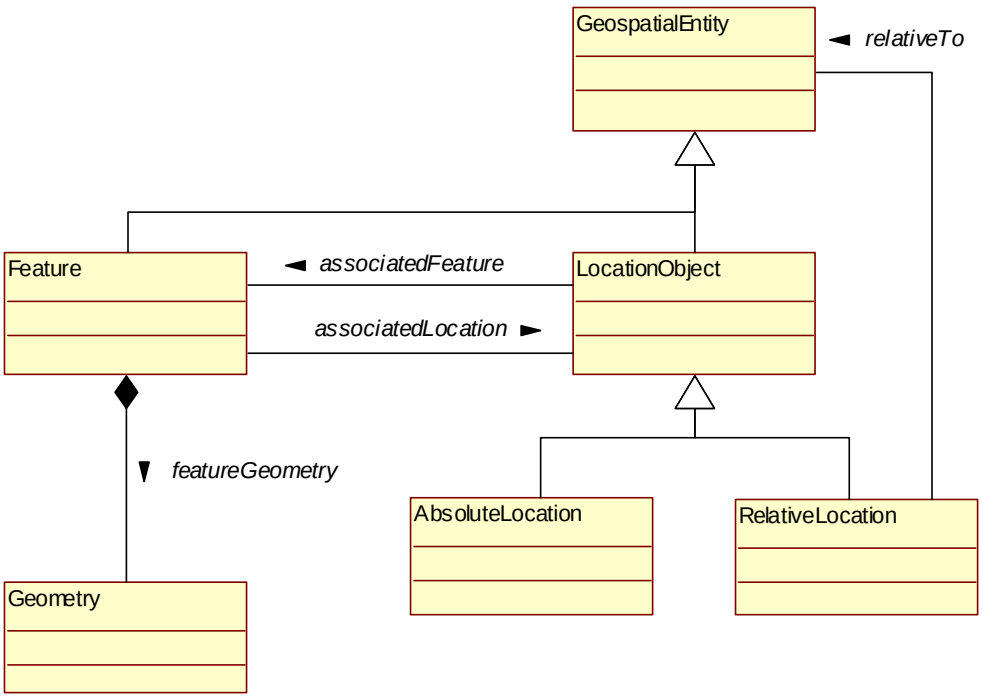
The Location Object describes a site or place in a normalized structure suitable for data interchange. A Feature describes real-world phenomena in a geospatial context. It may have an associated Location Object (or the Location Object may be associated with the Feature) to support transformation between 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 an engineering context with references to its geospatial location. An Observation associates an observed or measured value with the geospatial context of the observation. A Mobile Object describes real-world phenomena similar to a Feature that changes position or state

relatively rapidly. A Coverage associates a set of discrete values with a geospatial area. A Route describes a path between locations.

2.1 Location Object Class

A Location Object is a subtype of the Geospatial Entity and is used to specify a place or site somewhere in the world. The Location Object contains a normalized, structured description of a place or site on the Earth that is of interest in the HLS mission. A location is specified in terms of its absolute location within a system of reference or its location relative to another well-known point. The Location Object has Absolute Location and Relative Location subclasses to express these two types of location. This is illustrated in Exhibit 4.

Exhibit 4: Subtypes of the Location Object

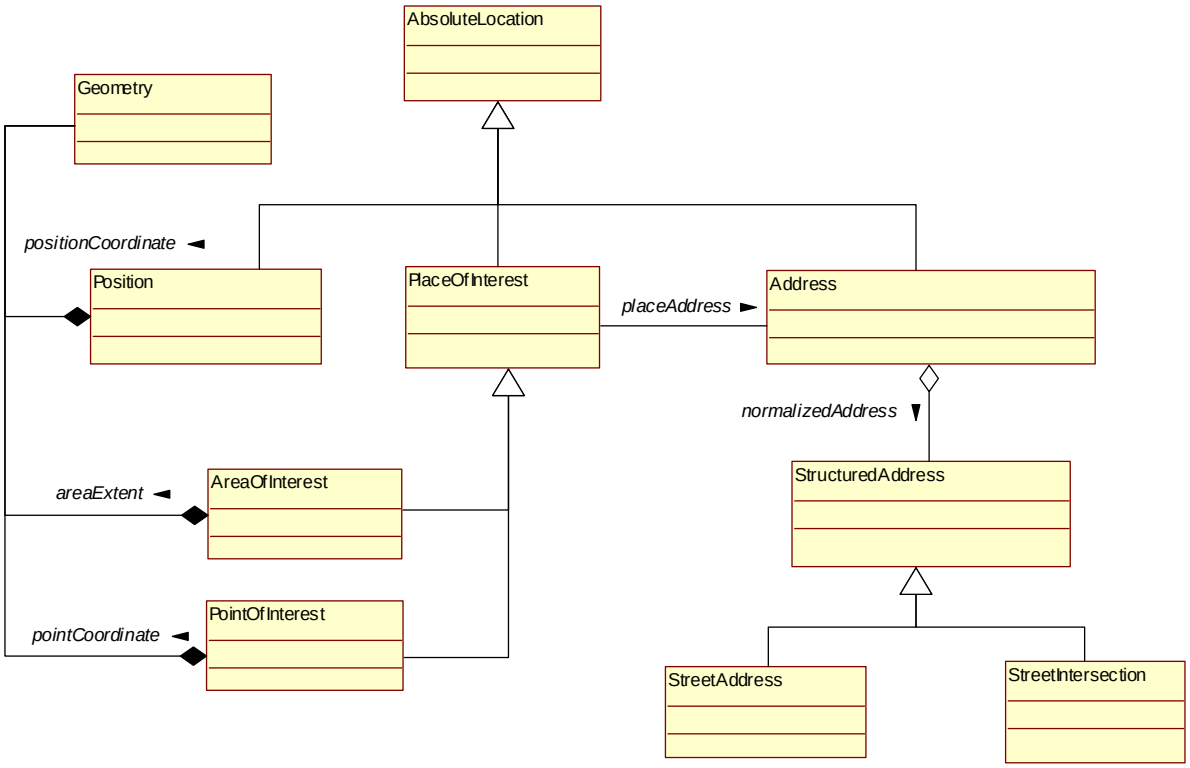


A Location Object may be associated with a Feature. For example, the Location Object implemented as an address for a school could be associated with the Feature for the school. To support symmetric transformations, a Feature can have an associated Location Object. For example, this would permit an application to determine the address of a feature from a geospatial dataset.

A Relative Location specifies a location in reference to another known geographic object (such as a feature or absolute location). For example, a relative location could be a linear reference (100 feet south of Grant Elementary School) or a network location (power transmission tower 17A231, a node on the electrical distribution grid).

An Absolute Location allows the specification of a location within a known reference system. Absolute locations can be specified by geographic coordinate, street address, place name, or an area of interest. Exhibit 5 illustrated the representations of an Absolute Location.

Exhibit 5: Absolute Location Hierarchy



A Position is used to represent a location by geographic or other coordinates, based on a coordinate reference system. A Place of Interest is a well-known place name that may have (and probably does have) an associated street address. An Area of Interest (AOI) specifies a geographic area or shape bounding an area that can be identified by name (such as the boundaries of a state) or a more transient area (such as the costal areas along a predicted storm track). A Point of Interest (POI) is a specialization of a Place of Interest in which the geometry is specified as a point (versus a polygon or other multi-dimensional shape).

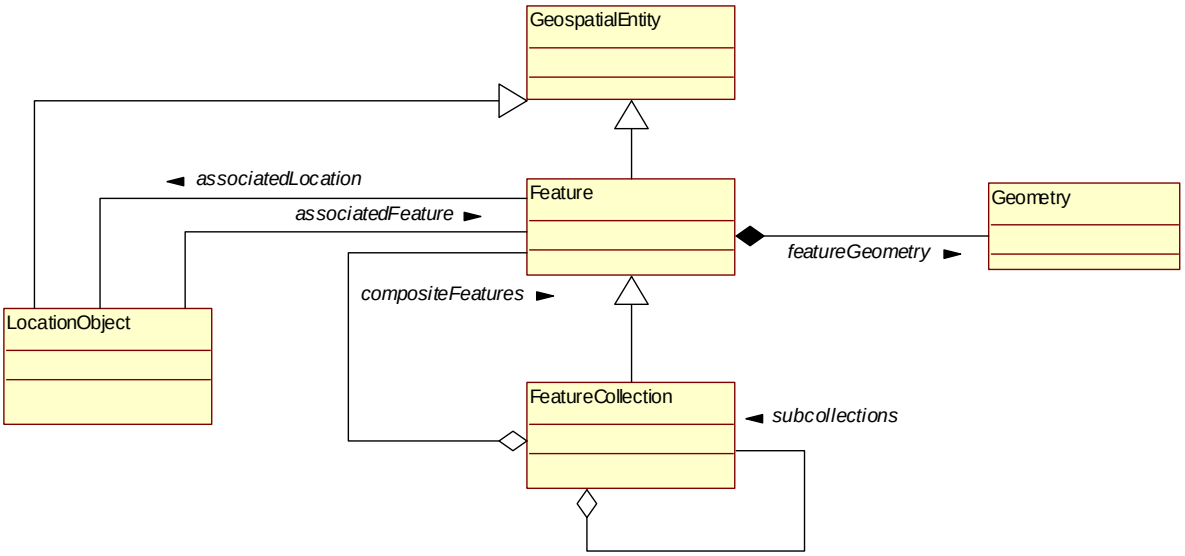
An Address is used to locate an object using named streets as reference. It provides a structural framework for the specification of addresses that can be more easily shared by automated systems and humans alike.

2.2 Feature and Feature Collection Classes

Within the context of geospatial data, a feature is an abstraction of real-world phenomena. A feature type defines the properties and constraints placed on a Feature. A Feature has a unique identity, a type (the feature type), and values for the properties that are defined through the feature type. The properties (or attributes) of a feature are particular to the type of feature being represented. For example, a property of a hospital (the feature type) might be the number of beds

(the property). A Feature represents a specific real-world object; in this example, a feature instance representing The George Washington University Hospital would have an attribute value for number of beds of 380. Exhibit 6 illustrates the hierarchy of the Feature object.

Exhibit 6: Feature Object Hierarchy



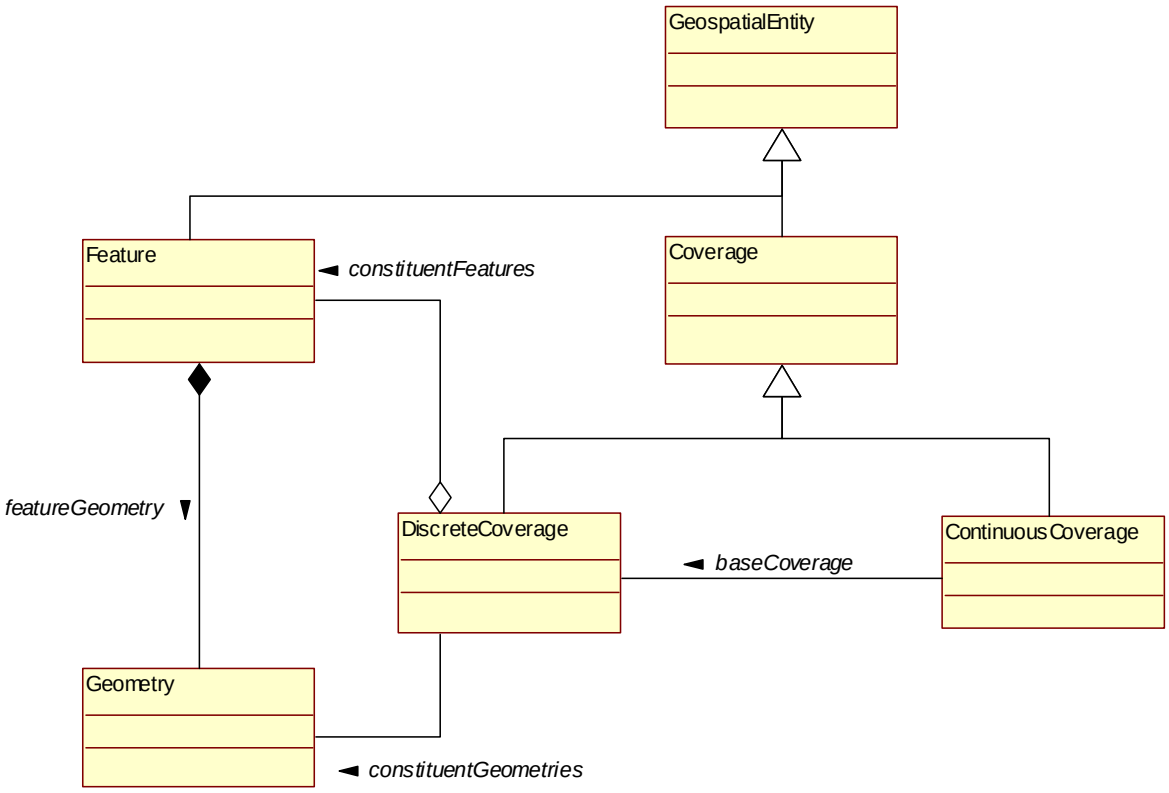
An attribute that is common to many feature types is geometry. Geometry is used to describe the geographic dimensions of the feature. It provides the location, orientation, and dimensions of a feature within the context of a reference system. The geometry for a feature can be as simple as a point (expressed as a latitude and longitude coordinate pair, for example) appropriate for discovery and display on a macro scale. A feature may also have associated geometry that is more complex, such as a description of the parcel of land and footprint of the improvements on the parcel appropriate for use in high-precision applications such as cadastral record keeping.

Within this data model, a feature can exist as a single feature or as a collection of features (including collections of collections). A Feature Collection can be treated as an instance of a feature and can contain one or more features. Feature collections are used to group features for convenience thematically, geographically, or in other ad hoc groupings. For example, a feature collection may be created that contains all hospitals (thematic grouping). In addition, there could be a collection that contains all hospitals in a given region (geographic grouping). A dynamic collection could be created in response to a query that includes all hospitals in a geographic area with more than 200 beds (an ad hoc collection based on the feature's property values).

2.3 Coverage Class

A Coverage is a feature that acts as a function to return one or more feature attribute values for any direct position within its spatiotemporal domain. An example would be a geolocated satellite image where each pixel of the image can be located using a latitude and longitude coordinate. The Coverage class is used to contain the reference to the coverage data and the functions used to return the feature attribute values for a given location. Exhibit 7 illustrates the hierarchy of the Coverage class.

Exhibit 7: Coverage Hierarchy



Coverages are implemented as one of two types: discrete and continuous. A Discrete Coverage has a finite collection of geometric objects and the direct positions contained in those objects within a spatiotemporal domain. An example of a Discrete Coverage is a set of weather reporting stations where each station has a direct position and a temperature value at a specified time. This is similar to the concept of a feature collection with the added dimension of time. A Discrete Coverage could provide an association or aggregation of Observations over a common area or time frame.

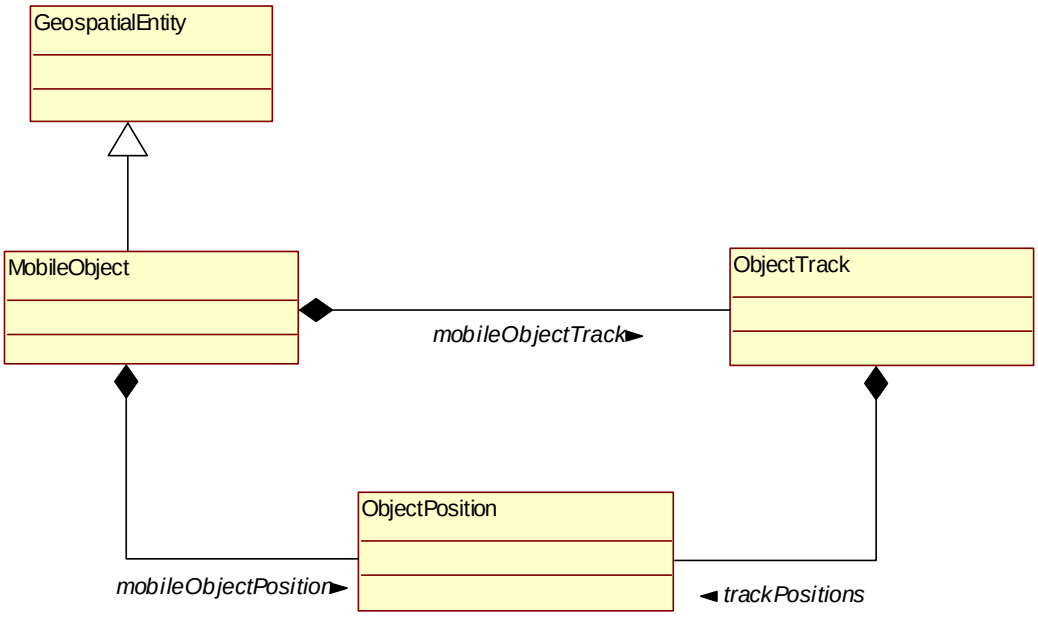
A Continuous Coverage consists of a set of direct positions in a coordinate space over a spatiotemporal domain. A Continuous Coverage maps direct positions to value records. Using the weather station example above, a Continuous Coverage would provide a temperature value for any location within the coverage extent at a specified time, regardless of whether or not the direct position corresponded to the location of a weather reporting station. The implementation of the function for the continuous coverage determines how the value is calculated (e.g. linear interpolation). A Continuous Coverage is very frequently associated with a Discrete Coverage providing a set of control values as a basis for evaluating the Continuous Coverage.

2.4 Mobile Object Class

A Mobile Object describes something that is being tracked or monitored. A Mobile Object is both geographically and temporally located. It has a position and an associated time when that

position was taken. In addition, the object has a status and an activity associated with the object. Exhibit 8 illustrates the structure of a Mobile Object.

Exhibit 8: Mobile Object Class

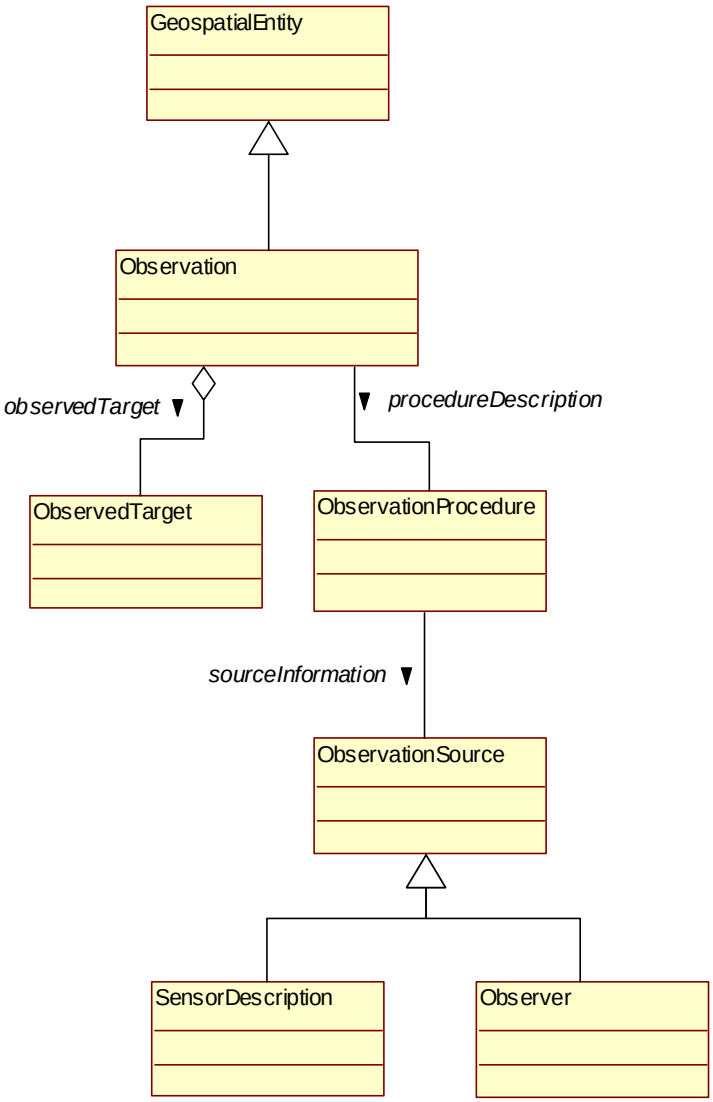


A Mobile Object is associated with two classes: the Object Position and the Object Track. The Object Position contains the current or most recent spatio-temporal location of the object, i.e. the geographic position of the object (including the quality of the position report) and the time that the position is valid. A Mobile Object has an associated Track History containing the historic (or predicted) states of the Mobile Object being tracked, including associated historic or predicted positions.

2.5 Observation Class

An observation is the act or event through which a number, term or other symbol (i.e. measurement) is assigned to a phenomenon at a location at a given point in time. An observation can be the measured value of a sensor (such as a water height meter or temperature sensor) or a report of activities at an observed location. As illustrated in Exhibit 9, an Observation is a subclass of a Geospatial Entity.

Exhibit 9: Observation Class Hierarchy

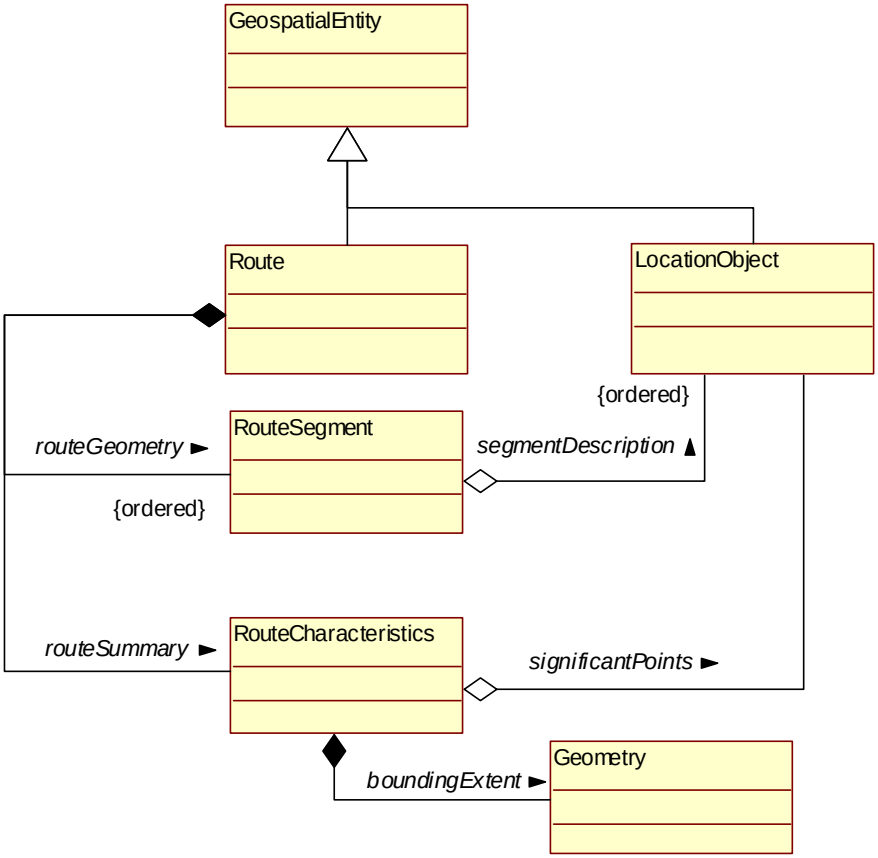


An Observation may be associated with an Observed Target, which describes the target or subject of the observation. An Observation has an associated Observation Procedure, which can be a process, instrument, or sensor. The associated Observation Source provides descriptive information on the source of the observation. Specifically, an Observation Source could be a Sensor Description or an Observer. The Sensor Description contains the characteristics, limitations and calibration information regarding the sensor that supplied the Observation. The Observer is a citation of the source of an Observation made through non-automated means, such as reporting on people entering and leaving a building.

2.6 Route Class

A route is a sequence of links, possibly including partial links, describing a path between two or more positions within a network. The Route class contains a summary of the route and the route geometry. Exhibit 10 illustrates the basic structure of the Route class.

Exhibit 10: Route Class

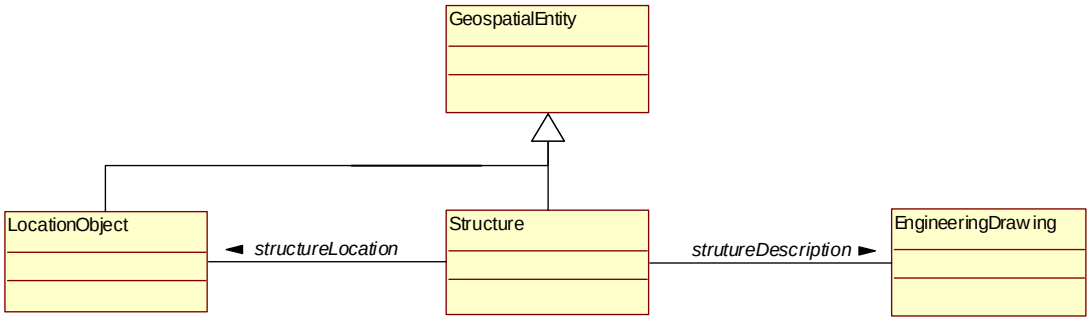


A Route has associated Route Characteristics that provide a summary of the route. The summary identifies significant points along the route (such as the starting and ending points and waypoints), the route distance and associated geographic extent of the route. The route geometry is described by an ordered list of Route Segments that describe a path between an ordered set of Location Objects.

2.7 Structure Class

A structure is a manmade object such as a building, bridge, or tunnel. The Structure class is similar to a feature in that it describes properties of the manmade object, but in more detail. As illustrated in Exhibit 11, the Structure class is used to associate engineering drawings or references to engineering data that describes a structure and the Location Object for that structure.

Exhibit 11: Structure Class



3.0 ACRONYMS

Acronym	Definition
AOI	Area of Interest
POI	Point of Interest
DHS	Department of Homeland Security
EA	Enterprise Architecture
GEA	Geospatial Enterprise Architecture
HLS	Homeland Security
TCP/IP	Transmission Control Protocol/Internet Protocol
URL	Uniform Resource Locator