Mplify Standard

Mplify 121.1

LSO Cantata and LSO Sonata Address Management API - Developer Guide

November 2025

Table of Contents

List of Contributing Members

The following members of Mplify participated in the development of this document and have requested to be included in this list.

Member
Amartus
Colt Technology Services
Proximus

Table 1: Contributing Members

1. Abstract

This standard is intended to assist implementation of the Address Validation functionality defined for the LSO Cantata and LSO Sonata Interface Reference Point (IRPs), for which requirements and use cases are defined in *Installation Place and Service Site Management Business Requirements and Use Cases* [Mplify 150].

The purpose of Address Validation API is to ensure that the Buyer and the Seller understand each other in terms of address representation. It is often the case that the same address may be represented in various ways. There are also cases where the Fielded or Formatted Address Representation might be ambiguous or there is no Fielded or Formatted Address Representation at all.

An additional goal of the Address Validation is to obtain the Seller's `GeographicAddress` identifier so that the Buyer may refer to it by reference hence speeding up the later conversation.

This standard consists of this document and complementary API definitions.

This standard normatively incorporates the following files by reference as if they were part of this document, from the GitHub repository:

https://github.com/MEF-GIT/MEF-LSO-Sonata-SDK

commit id: aaa03d484f98664a5a14f4f54f47b675d7efb3b8

- `productApi/serviceability/address/geographicAddressManagement.api.yaml`
- `productApi/serviceability/address/geographicAddressNotification.api.yaml`

https://github.com/MEF-GIT/MEF-LSO-Cantata-SDK

commit id: 83d6edd0c70386058a9af6e677c069b498671da7

- `productApi/serviceability/address/geographicAddressManagement.api.yaml`
- `productApi/serviceability/address/geographicAddressNotification.api.yaml`

2. Terminology and Abbreviations

This section defines the terms used in this document. In many cases, the normative definitions of terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other Mplify or external documents.

In addition, terms defined in the standards referenced below are included in this document by reference and are not repeated in the table below:

- MEF 50.1
- MEF 55.1
- MEF 55.1.1
- Mplify 150

Term	Description	Reference
Alternate Geographic Addresses	An array of zero or more Geographic Addresses with Geographic Address Representations known to the Seller that are considered by the Seller to be an alternate to the Buyer Specified Geographic Address Representations.	This document; adapted from [Mplify 150]
Area of Validation	The areas of the world in which a Seller can validate addresses such as a state, province, or country.	[Mplify 150]
Deferred Response	A Seller's response to a Buyer's Validate Geographic Address request whereby the Seller immediately (less than 30 seconds) acknowledges that the Validate Geographic Address request was received and, over time, sends notifications to update the Buyer on the state and results of the Validate Geographic Address request (assuming the Buyer has subscribed to receive the notifications). A Deferred Response may take some time for the Seller to fulfill.	[Mplify 150]
Fielded Address Representation	A type of Representation where a discrete field and value for each type of boundary or identifier down to the lowest level of detail. For example, "street number" is one field, "street name" is another field, etc.	This document; adapted from [Mplify 150]
Formatted Address Representation	A type of Representation using single string based on local postal addressing conventions.	This document; adapted from [Mplify 150]
Geographic Address	A place on Earth, which may or may not be fixed, described using one or more Geographic Address Representations.	This document; adapted from [Mplify 150]

Geographic Address Representation	A concrete method of describing a specific address which uses well defined formats to detail the attributes.	This document; adapted from [Mplify 150]
Geographic Point Representation	A type of Representation where coordinates (latitude, longitude and sometimes elevation) are used to specify a particular place on Earth.	This document; adapted from [Mplify 150]
Geographic Site	A fixed or mobile place at which a Product can be installed.	This document; adapted from [Mplify 150]
Label Representation	A type of Geographic Address Representation that is a unique combination of label and Administrative Authority (any organization that distributes labels) that controls assignment of the label and that specifies either a place which may or may not be fixed on Earth.	This document; adapted from [Mplify 150]
Requesting Entity	The business organization that is acting on behalf of one or more Buyers. In the most common case, the Requesting Entity represents only one Buyer and these terms are then synonymous.	[Mplify 150]
Responding Entity	The business organization that is acting on behalf of one or more Sellers. In the most common case, the Responding Entity represents only one Seller and these terms are then synonymous.	[Mplify 150]
REST API	Representational State Transfer. REST provides a set of architectural constraints that, when applied as a whole, emphasizes scalability of component interactions, generality of interfaces, independent deployment of components, and intermediary components to reduce interaction latency, enforce security, and encapsulate legacy systems.	[REST]

Table 2. Terminology

3. Compliance Levels

The key words **"MUST"**, **"MUST NOT"**, **"REQUIRED"**, **"SHALL"**, **"SHALL NOT"**, **"SHOULD"**, **"SHOULD NOT"**, **"RECOMMENDED"**, **"NOT RECOMMENDED"**, **"MAY"**, and **"OPTIONAL"** in this document are to be interpreted as described in BCP 14 ([RFC2119], [RFC8174]) when, and only when, they appear in all capitals, as shown here. All key words must be in bold text.

Items that are **REQUIRED** (contain the words **MUST** or **MUST NOT**) are labeled as **[Rx]** for required. Items that are **RECOMMENDED** (contain the words **SHOULD** or **SHOULD NOT**) are labeled as **[Dx]** for desirable. Items that are **OPTIONAL** (contain the words MAY or OPTIONAL) are labeled as **[Ox]** for optional.

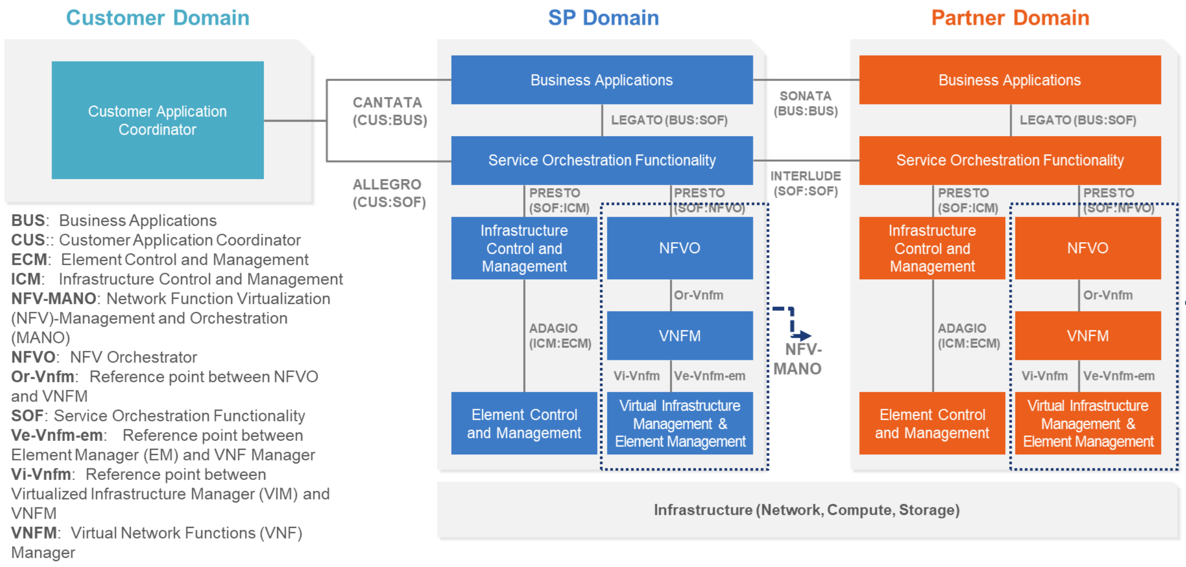
A paragraph preceded by **[CRa]<** specifies a conditional mandatory requirement that **MUST** be followed if the condition(s) following the "<" have been met. For example, **"[CR1] <[D38]"** indicates that Conditional Mandatory Requirement 1 must be followed if Desirable Requirement 38 has been met. A paragraph preceded by **[CDb]<** specifies a Conditional Desirable Requirement that **SHOULD** be followed if the condition(s) following the "<" have been met. A paragraph preceded by **[COc]<**specifies a Conditional Optional Requirement that **MAY** be followed if the condition(s) following the "<" have been met.

4. Introduction

Note: The requirements and use cases for Address Validation functionality are defined in *Installation Place and Service Site Management Business Requirements and Use Cases* [Mplify 150] which introduced the *Installation Place* as a new entity with multiple address representations. For the sake of backward and TMF compatibility the API definition does not introduce *Installation Place* as a new root API resource, but updates the existing model of `GeographicAddress`, according to before-mentioned Mplify Standard.

This API standard is based on TMF 673 API as specified by *TMF673 Geographic Address Management API User Guide* [TMF673].

This standard specification document describes the API for Address Validation functionality of the LSO Cantata and Sonata Interface Reference Point (IRP) as defined in the MEF 55.1 *Lifecycle Service Orchestration (LSO): Reference Architecture and Framework* [MEF 55.1]. The LSO Reference Architecture is shown in Figure 1.



Customer Domain
SP Domain
Partner Domain
Customer Application Coordinator
CANTATA (CUS:BUS)
ALLEGRO (CUS:SOF)
Business Applications
LEGATO (BUS:SOF)
Service Orchestration Functionality
PRESTO (SOF:ICM)
PRESTO (SOF:NFVO)
Infrastructure Control and Management
NFVO
Or-Vnfm
ADAGIO (ICM:ECM)
VNFM
Vi-Vnfm
Ve-Vnfm-em
Element Control and Management
Virtual Infrastructure Management & Element Management
SONATA (BUS:BUS)
INTERLUDE (SOF:SOF)
NFV-MANO
Infrastructure (Network, Compute, Storage)
BUS: Business Applications
CUS:: Customer Application Coordinator
ECM: Element Control and Management
ICM: Infrastructure Control and Management
NFV-MANO: Network Function Virtualization (NFV)-Management and Orchestration (MANO)
NFVO: NFV Orchestrator
Or-Vnfm: Reference point between NFVO and VNFM
SOF: Service Orchestration Functionality
Ve-Vnfm-em: Reference point between Element Manager (EM) and VNF Manager
Vi-Vnfm: Reference point between Virtualized Infrastructure Manager (VIM) and VNFM
VNFM: Virtual Network Functions (VNF) Manager

Figure 1. The LSO Reference Architecture

Cantata and Sonata IRPs define pre-ordering and ordering functionalities that allow an automated exchange of information between business applications of the Buyer (Customer or Service Provider) and Seller (Service Provider or Partner) Domains. Those are:

- Address Validation
- Site Retrieval
- Product Offering Qualification
- Quote
- Product Offering Availability and Pricing Discovery
- Product Inventory
- Product Ordering
- Trouble Ticketing
- Billing

This document focuses on implementation aspects of Address Validation functionality and is structured as follows:

- Chapter 4 provides an introduction to Address Validation and its description in a broader context of Cantata and Sonata and their corresponding SDKs.
- Chapter 5 gives an overview of endpoints, resource model and design patterns.
- Use cases and flows are presented in Chapter 6.
- And finally, Chapter 7 complements previous sections with a detailed API description.

4.1. Conventions in the Document

- Code samples are formatted using code blocks. When notation `<< some text >>` is used in the payload sample it indicates that a comment is provided instead of an example value and it might not comply with the OpenAPI definition.
- Model definitions are formatted as in-line code (e.g. `GeographicAddress`).
- In UML diagrams the default cardinality of associations is `0..1`. Other cardinality markers are compliant with the UML standard.
- In the API details tables and UML diagrams required attributes are marked with a * next to their names.
- In UML sequence diagrams `{{variable}}` notation is used to indicate a variable to be substituted with a correct value.

4.2. Framework

As presented in Figure 2. both Cantata and Sonata API frameworks consist of three structural components:

- Generic API framework
- Product-independent information (Function-specific information and Function-specific operations)
- Product-specific information (Mplify product specification data model)

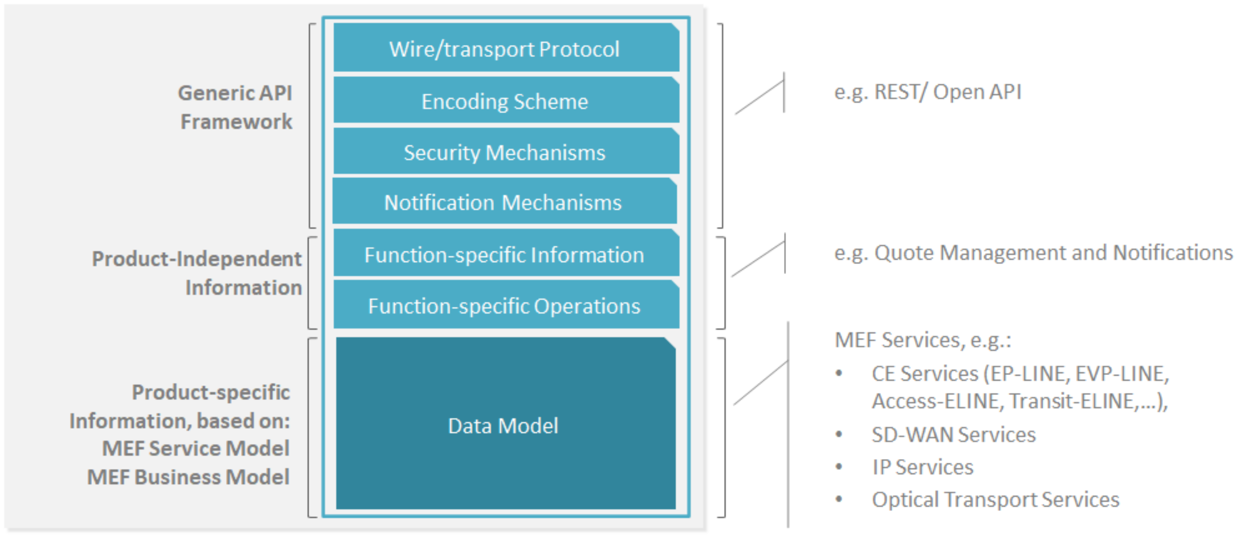

Generic API Framework
Product-Independent Information
Product-specific Information, based on: MEF Service Model MEF Business Model
Wire/transport Protocol
Encoding Scheme
Security Mechanisms
Notification Mechanisms
Function-specific Information
Function-specific Operations
Data Model
e.g. REST/ Open API
e.g. Quote Management and Notifications
MEF Services, e.g.:
CE Services (EP-LINE, EVP-LINE, Access-ELINE, Transit-ELINE,...),
SD-WAN Services
IP Services
Optical Transport Services

Figure 2. Cantata and Sonata API framework

The essential concept behind the framework is to decouple the common structure, information, and operations from the specific product information content.
Firstly, the Generic API Framework defines a set of design rules and patterns that are applied across all Cantata or Sonata APIs.
Secondly, the product-independent information of the framework focuses on a model of a particular Cantata or Sonata functionality and is agnostic to any of the product specifications.
Finally, the product-specific information part of the framework focuses on Mplify product

specifications that define business-relevant attributes and requirements for trading Mplify subscriber and Mplify operator services.

The Address Validation API is product-agnostic in its nature and is not intended to carry any product-specific information. It operates using the Generic API Framework and the Function-specific Information and Operations.

Address Validation is part of a broader Cantata and Sonata End-to-End flow. Figure 3. below shows a high-level diagram to get a good understanding of the whole process and Address Validation's position within it.

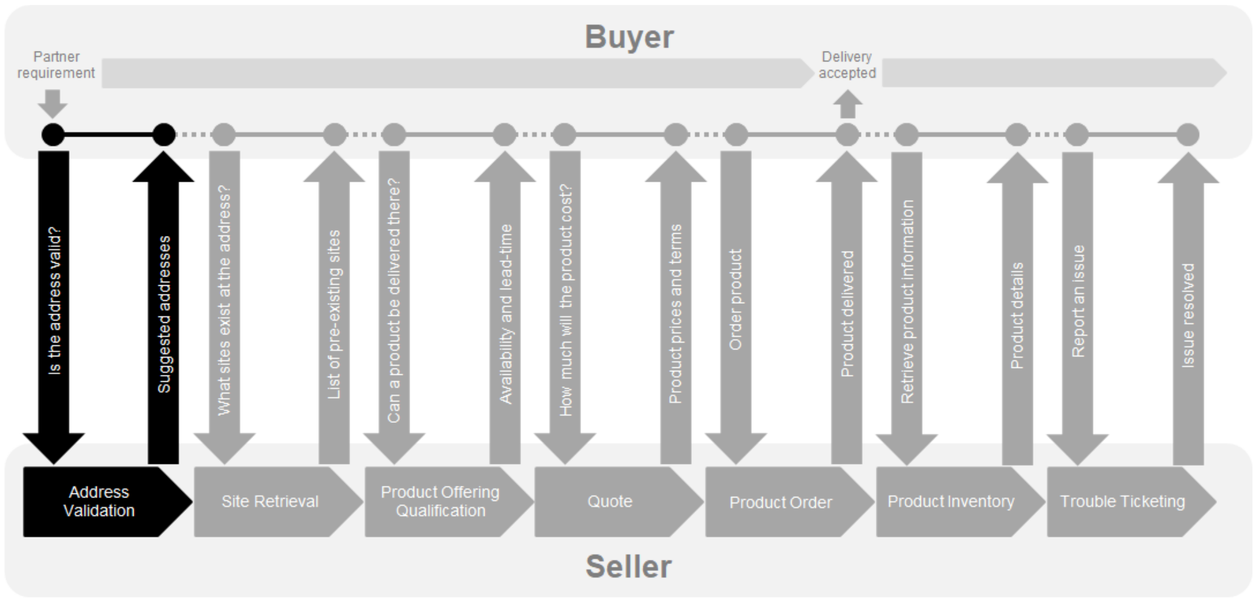


Figure 3. Cantata and Sonata End-to-End Function Flow

- Address Validation:
  - Allows the Buyer to retrieve address information from the Seller, including exact formats, for Geographic Addresses known to the Seller.
- Site Retrieval:
  - Allows the Buyer to retrieve Geographic Site information including exact formats for Geographic Sites known to the Seller.
- Product Offering Qualification (POQ):
  - Allows the Buyer to check whether the Seller can deliver a product or set of products from among their product offerings at the geographic address or a Geographic Site specified by the Buyer; or modify a previously purchased product.
- Quote:
  - Allows the Buyer to submit a request to find out how much the installation of an instance of a Product Offering, an update to an existing Product, or a disconnect of an existing Product will cost.
- Product Order:
  - Allows the Buyer to request the Seller to initiate and complete the fulfillment process of an installation of a Product Offering, an update to an existing Product, or a disconnect of an existing Product at the address defined by the Buyer.
- Product Inventory:
  - Allows the Buyer to retrieve the information about existing Product instances from Seller's Product Inventory.
- Trouble Ticketing:
  - Allows the Buyer to create, retrieve, and update Trouble Tickets as well as receive notifications about Incidents' and Trouble Tickets' updates. This allows managing

issues and situations that are not part of normal operations of the Product provided by the Seller.

This document focuses on the first function shown in black. A Buyer asks a Seller if they understand a given Geographic Address Representation. The Seller may:

- Confirm that the Geographic Address Representation(s) to be validated is a best match for a Representation of an Geographic Address known by the Seller.
- Provide one or more Geographic Address Representation suggestions for the Geographic Address the Seller believes could alternatives to the Buyer's Geographic Address Representation.

When one or more suggestions are provided by the Seller, the Seller may optionally indicate which one they believe is the most likely to be a match.

5. API Description

This section discusses the API structure and design patterns. It starts with the high-level use cases diagram and then it describes the REST endpoints with use case mapping.

5.1. High-level use cases

Figure 4 presents a high-level use case diagram. This picture aims to help understand the endpoint mapping. Use cases are described extensively in chapter 6. Use case numbering is kept consistent with Mplify 150. The underlined font designates required use cases.

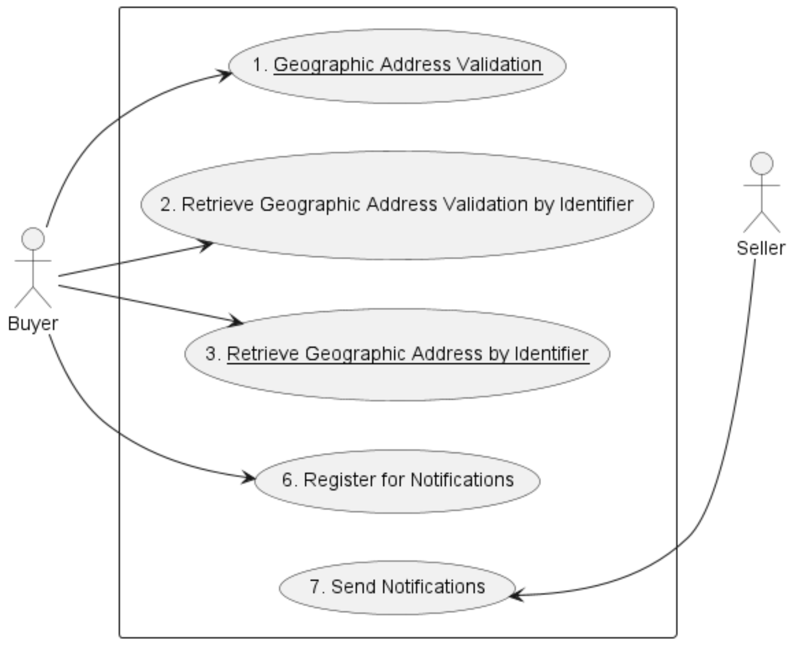

1. Geographic Address Validation
2. Retrieve Geographic Address Validation by Identifier
3. Retrieve Geographic Address by Identifier
6. Register for Notifications
7. Send Notifications
Buyer
Seller

Figure 4. High-level use cases

5.2. Resource/endpoint Description

5.2.1. Seller Side Endpoints

Base URL for Cantata:

```
https://{{serverBase}}:{{port}}
{{?/seller_prefix}}/mefApi/cantata/geographicAddressManagement/v2/
```

Base URL for Sonata:

```
https://{{serverBase}}:{{port}}
{{?/seller_prefix}}/mefApi/sonata/geographicAddressManagement/v8/
```

Note: All examples will include only the Sonata version of the Base Path.

Following endpoints are exposed by the Seller and allow the Buyer to:

- Validate Geographic Address
- Retrieve a Geographic Address Validation by Identifier
- Retrieve a Geographic Address by Identifier
- Register for Notifications

The endpoints and corresponding data model are defined in `productApi/serviceability/address/geographicAddressManagement.api.yaml`.

API endpoint	Use Case Name	Mplify 150 Use case Mapping
`POST /geographicAddressValidation`	Validate Geographic Address	UC 1: Validate Installation Place
`GET /geographicAddressValidation/{id}`	Retrieve Geographic Address Validation by Identifier	UC 2: Retrieve Validate Installation Place Request by Validate Installation Place Request Identifier
`GET /geographicAddress/{id}`	Retrieve Geographic Address by Identifier	UC 3: Retrieve Installation Place by Installation Place Identifier
`POST /hub`	Register for Notifications	UC 6: Register for Notifications
`GET /hub/{{id}}`	Register for Notifications	UC 6: Register for Notifications
`DELETE /hub/{{id}}`	Register for Notifications	UC 6: Register for Notifications

Table 3. End point to use case mapping - Seller Side

5.2.2. Buyer Side Endpoints

Base URL for Cantata:

```
https://{{serverBase}}:{{port}}
{{?/buyer_prefix}}/mefApi/cantata/geographicAddressNotification/v2/
```

Base URL for Sonata:

```
https://{{serverBase}}:{{port}}
{{?/buyer_prefix}}/mefApi/sonata/geographicAddressNotification/v8/
```

The following API Endpoints are used by the Seller to post notifications to registered listeners. The endpoints and corresponding data model are defined in `productApi/serviceability/address/geographicAddressNotification.api.yaml`

API Endpoint	Use Case Name	Mplify 150 Use Case Mapping
`POST /listener/geographicAddressValidationStateChangeEvent`	Send Notification	UC 7: Send Notification

Table 4. End point to use case mapping - Buyer Side

5.2.3. Specifying the Buyer ID and the Seller ID

A business entity willing to represent multiple Buyers or multiple Sellers must follow requirements of [Mplify 150] chapter 8.8, which states:

> For requests of all types, there is a business entity that is initiating an Operation (called a Requesting Entity) and a business entity that is responding to this request (called the Responding Entity). In the simplest case, the Requesting Entity is the Buyer, and the Responding Entity is the Seller. However, in some cases, the Requesting Entity may represent more than one Buyer and similarly, the Responding Entity may represent more than one Seller.

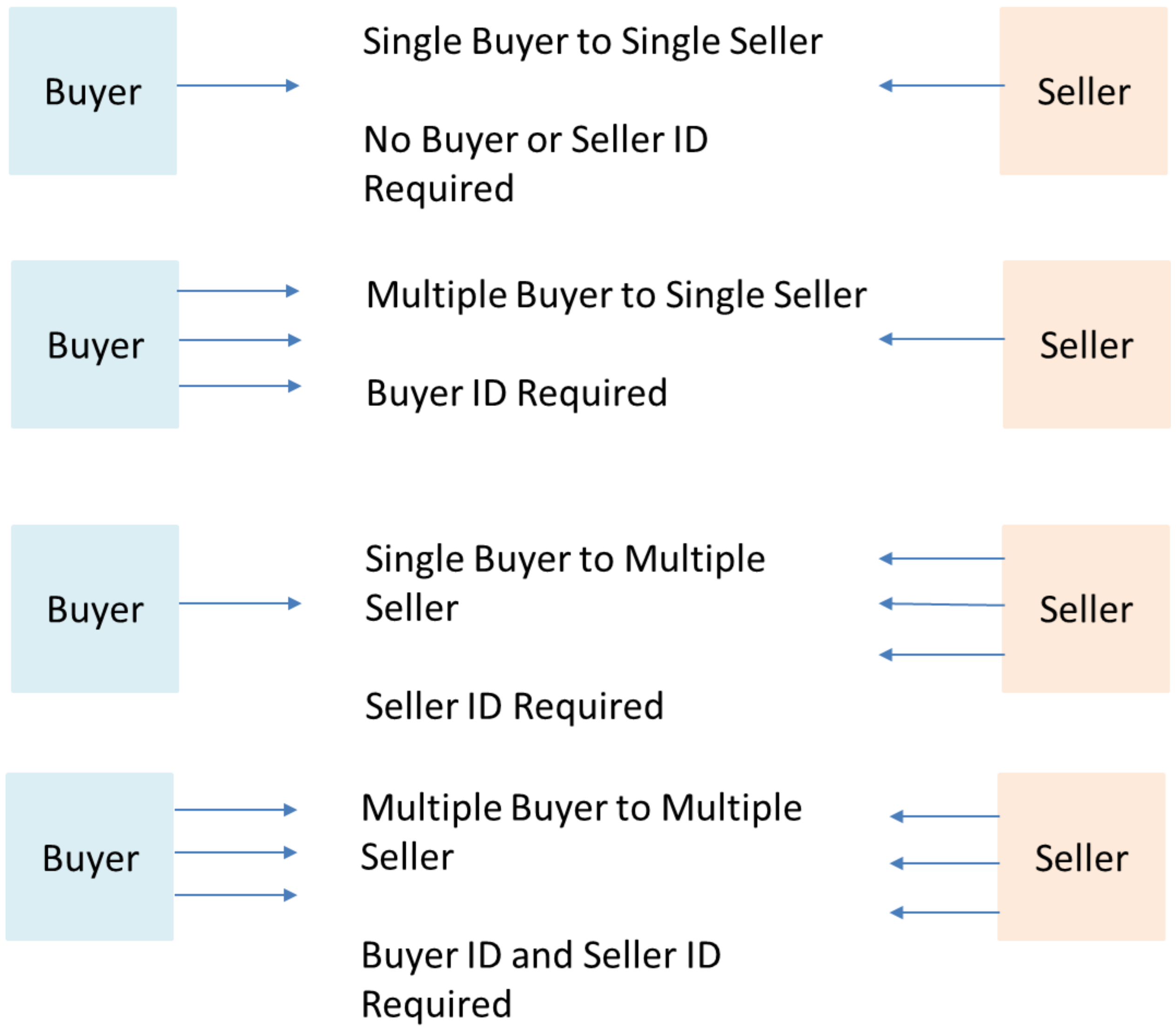

Buyer
Single Buyer to Single Seller
No Buyer or Seller ID Required
Seller
Buyer
Multiple Buyer to Single Seller
Buyer ID Required
Seller
Buyer
Single Buyer to Multiple Seller
Seller ID Required
Seller
Buyer
Multiple Buyer to Multiple Seller
Buyer ID and Seller ID Required
Seller

Figure 5. Buyer ID and Seller ID Examples

> As shown in Figure 5, if a Requesting Entity representing a single Buyer is doing business with a Responding Entity representing a single Seller, Buyer and Seller IDs are not required to be passed between the two entities. If a Requesting Entity representing more than one Buyer is doing business with a Responding Entity representing a single Seller, the Buyer ID is required to be passed between the two entities. If a Requesting Entity representing a single Buyer is doing business with a Responding entity representing multiple Sellers, the Seller ID is required to be passed between the two entities. If a Requesting Entity representing multiple Buyers is doing business with a Responding Entity representing multiple Sellers, both the Buyer ID and the Seller ID are required to be passed between the entities.

> While it is outside the scope of this specification, it is assumed that the Requesting Entity and the Responding Entity are aware of each other and can authenticate requests initiated by the other party. It is further assumed that the Requesting Entity knows:
>
> - the list of Buyers the Requesting Entity represents when interacting with this Responding Entity; and
> - the list of Sellers that this Responding Entity represents to this Requesting Entity.
>
> It is also assumed that the Responding Entity knows:
>
> - the list of Sellers that this Responding Entity represents to this Requesting Entity and
> - the list of Buyers the Requesting Entity represents when interacting with this Responding Entity.

In the API the `buyerId` and `sellerId` are represented as optional query parameters in each operation defined.

[R1] If the Requesting Entity has the authority to represent more than one Buyer the request **MUST** include `buyerId` that identifies the Buyer being represented. [Mplify150 R62]

[R2] If the Responding Entity represents more than one Seller to this Buyer the request **MUST** include `sellerId` that identifies the Seller with whom this request is associated. [Mplify150 R63]

5.3. API Resource Schema summary

This subchapter describes the entities from the resource model included in the API specification.

Each entity is a simple or composed type (with the use of `allOf` keyword for data types composition). A simple type defines a set of properties that might be of an object, primitive, or reference type.

Section 6 provides examples of data model and API usage. For a detailed description of the data model, please refer to API Details.

Figure 6 presents the data model for use cases 1-3 (not including Errors).

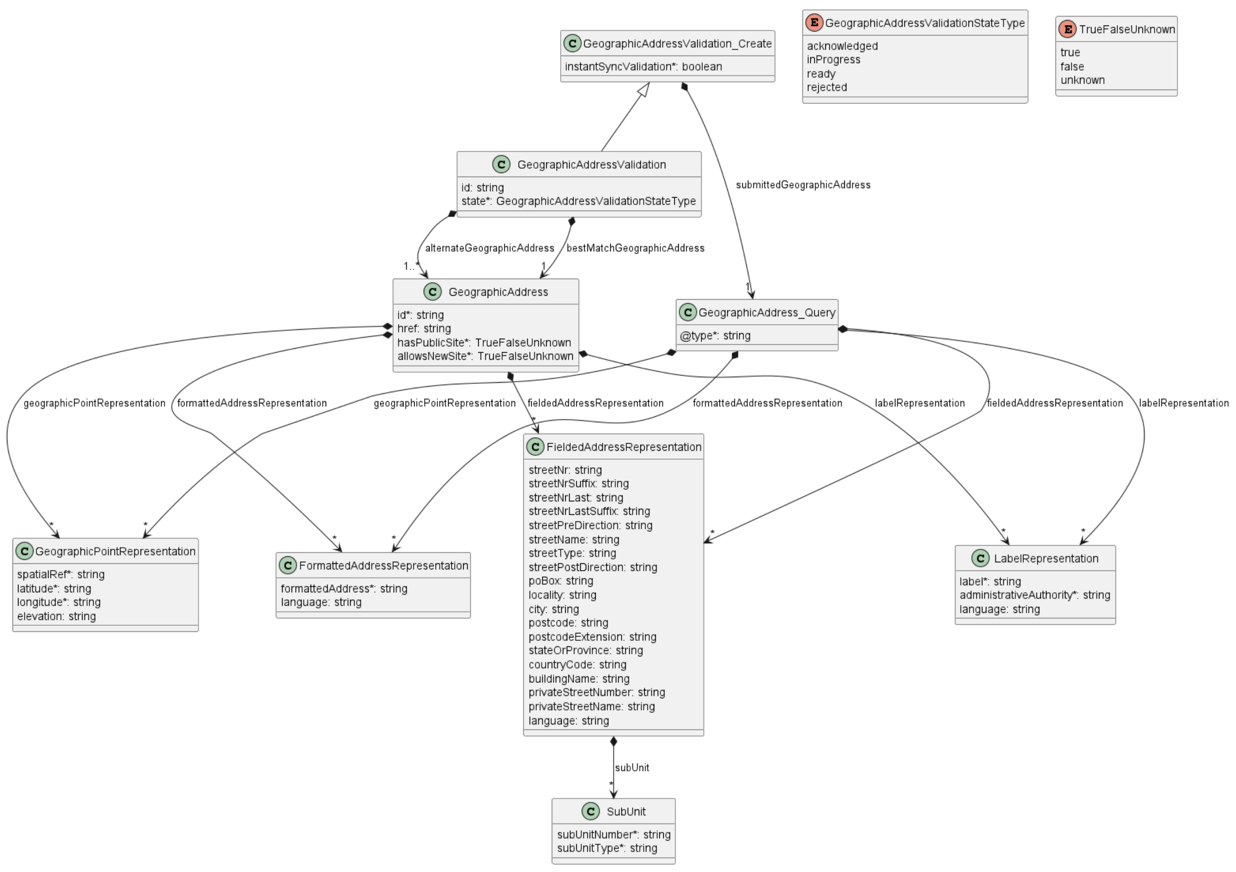

GeographicAddressValidation_Create
instantSyncValidation*: boolean
GeographicAddressValidationStateType
acknowledged
inProgress
ready
rejected
TrueFalseUnknown
true
false
unknown
GeographicAddressValidation
id: string
state*: GeographicAddressValidationStateType
submittedGeographicAddress
alternateGeographicAddress
bestMatchGeographicAddress
1..*
1
1
GeographicAddress
id*: string
href: string
hasPublicSite*: TrueFalseUnknown
allowsNewSite*: TrueFalseUnknown
GeographicAddress_Query
@type*: string
geographicPointRepresentation
formattedAddressRepresentation
geographicPointRepresentation
fieldedAddressRepresentation
formattedAddressRepresentation
labelRepresentation
fieldedAddressRepresentation
labelRepresentation
FieldedAddressRepresentation
streetNr: string
streetNrSuffix: string
streetNrLast: string
streetNrLastSuffix: string
streetPreDirection: string
streetName: string
streetType: string
streetPostDirection: string
poBox: string
locality: string
city: string
postcode: string
postcodeExtension: string
stateOrProvince: string
countryCode: string
buildingName: string
privateStreetNumber: string
privateStreetName: string
language: string
GeographicPointRepresentation
spatialRef*: string
latitude*: string
longitude*: string
elevation: string
FormattedAddressRepresentation
formattedAddress*: string
language: string
LabelRepresentation
label*: string
administrativeAuthority*: string
language: string
subUnit
SubUnit
subUnitNumber*: string
subUnitType*: string

Figure 6. Data Model

Note: While showing the extends relation, for clarity, the extending type lists only added attributes, not the sum with the extended type.

`GeographicAddressValidation_Create` is a subset of the `GeographicAddressValidation` type and is used as a request body. It contains only attributes that must be set by the Buyer. The Seller then enriches the entity in the response with additional information (e.g. `bestMatchGeographicAddress` and `alternateGeographicAddress`).

[R3] If an entity is used in the request or response, all properties marked as required **MUST** be provided.

[R4] `language` **MUST** use the ISO 639:2023 two letter codes. [Mplify150 R8], [Mplify150 R11], [Mplify150 R13]

Note: Having the `language` attribute and representations as lists allows the Seller to store representations in multiple languages for a single Geographic Address.

The root class of address representation is the `GeographicAddress`. An address is mainly described by one or more representations. There are four types of representations:

- `FieldedAddressRepresentation`
- `FormattedAddressRepresentation`
- `LabelRepresentation`
- `GeographicPointRepresentation`

A Buyer can use any combination of these representation types when submitting a Validate Geographic Address request. As an example, a Buyer may include a `FieldedAddressRepresentation` and a `GeographicPointRepresentation` in a single request.

This provides the Seller with the most information that the Buyer can provide in an attempt to validate the Geographic Address.

Multiple Geographic Addresses can have the same representation. Usually, the same values of `GeographicPointRepresentation`, may be used in Addresses representing rooms in one building. Each Geographic Address covered by such Geographic Point Representation has its own `id`.

5.3.1. Fielded Address Representation

Example of a `FieldedAddressRepresentation`

```
{
  "streetType": "st.",
  "streetName": "E. Wasilewskiego",
  "streetNr": "20",
  "city": "Cracow",
  "stateOrProvince": "Lesser Poland",
  "postcode": "30-305",
  "countryCode": "pl",
  "subUnit": [
    {
      "subUnitType": "floor",
      "subUnitNumber": "4"
    },
    {
      "subUnitType": "apartment",
      "subUnitNumber": "14"
    }
  ],
  "language": "en"
}
```

A subset of available attributes is used to describe the Geographic Address. There is an optional `subUnit` structure that can be used to specify precise location e.g. within a building. A list of Sub Units is to be used only to represent a hierarchy that point to single bottom level Sub Unit. Not to represent a list of "sibling" Sub Units or all Sub Units within an Geographic Address.

In the example above, an apartment number 14 on 4th floor in the building at the given address is specified using this structure.

A more precise location could be specified, but that would constitute a separate Geographic Address instance, identified by a separate `id`:

```
{
  "subUnit": [
    {
      "subUnitType": "floor",
      "subUnitNumber": "4"
    },
    {
      "subUnitType": "apartment",
      "subUnitNumber": "14"
    },
    {
      "subUnitType": "bay",
      "subUnitNumber": "South"
    },
    {
      "subUnitType": "cage",
      "subUnitNumber": "3"
    }
    ]
  }
```

[R5] The Buyer and Seller **MUST** agree to a minimum set of attributes for `FieldedAddressRepresentation` which they agree to support for describing a Geographic Address. [Mplify150 R2], [Mplify150 R6], [Mplify150 O3]

[O1] `streetName` **MAY** contain the `streetType` or `streetType` **MAY** be used as a stand-alone field. [Mplify150 O1]

Example:

```
  {
    "streetName": "Edmunda Wasilewskiego st."
  }
```

or:

```
  {
    "streetType": "st.",
    "streetName": "Edmunda Wasilewskiego"
  }
```

[O2] If a single `FieldedAddressRepresentation` has more than one street number, the `streetNr` and `streetNrLast` **MAY** be used to represent start and the end of the range. [Mplify150 O2]

For example if the building has a number like "20-22" it may be expressed as:

```
  {
    "streetNr": "20-22"
  }
```

or:

```
  {
    "streetNr": "20",
    "streetNrLast": "22"
  }
```

[R6] `streetNrLastSuffix` **MUST** only be used when there is a `streetNrLast` present. [Mplify150 R3]

[R7] `streetPreDirection` **MUST** be used when the direction of the street comes before the `streetName`. [Mplify150 R4]

[R8] `streetPostDirection` **MUST** be used when the direction of the street comes after the `streetName`. [Mplify150 R5]

In some cases a `FieldedAddressRepresentation` may contain both `streetPreDirection` and `streetPostDirection`

[R9] `countryCode` **MUST** use the ISO 3166 two letter codes. [Mplify150 R7]

The use of the `language` attribute is strongly recommended to clarify the language used for the Fielded Address Representation.

5.3.2. Formatted Address Representation

```
{
  "formattedAddress": "st. Edmunda Wasilewskiego 20/14, floor 4, 30-305, Cracow, Poland",
  "language": "en"
}
```

`FormattedAddressRepresentation` uses single string field to describe the address details.

[R10] Following attribute **MUST** be provided when specifying `FormattedAddressRepresentation`: [Mplify150 R11]

- `formattedAddress`

[R11] The Buyer and Seller **MUST** agree if they also require the `language` attribute for `FormattedAddressRepresentation`. [Mplify150 R2]

5.3.3. Label Representation

```
{
  "administrativeAuthority": "CLLI",
  "label": "PLTXCL01"
}
```

The Label represents a unique identifier controlled by a generally accepted independent Administrative Authority or standard body. It can be used to identify things that do not have a static Geographic Address, such as airplanes or ships. In this case, the unique identifier (i.e., airplane tail number) for the airplane or ship is used.

The example above is a place that represents a CLLI (Common Language Location Identifier) identifier which is commonly used to refer locations in North America for network equipment installations.

[R12] Following attributes **MUST** be provided when specifying `LabelRepresentation`: [Mplify150 R12]

- `administrativeAuthority`
- `label`

[R13] The Buyer and Seller **MUST** agree if they also require the `language` attribute for `LabelRepresentation`. [Mplify150 R2]

5.3.4. Geographic Point Representation

```
{
  "spatialRef": "EPSG:4326",
  "latitude": "50.048868",
  "longitude": "19.929523"
}
```

This representation uses spatial coordinates to describe a place. `spatialRef` determines the standard that has to be used to interpret coordinates provided in `latitude`, `longitude` and `elevation` values.

This type allows only providing a point. It cannot carry more detailed information like the floor number from previous examples.

[R14] Following attributes **MUST** be provided when specifying `GeographicPointRepresentation`: [Mplify150 R14]

- `spatialRef`
- `latitude`
- `longitude`

[R15] The `spatialRef` value that can be used **MUST** be agreed upon between Buyer and Seller during the onboarding process. [Mplify150 R16]

[R16] The Buyer and Seller **MUST** agree to the level of accuracy of the `latitude`, `longitude` and `elevation`. [Mplify150 R15]

Level of accuracy in this context means the number of decimal points used in the `latitude`, `longitude` and `elevation`.

[R17] The Buyer and Seller **MUST** agree if they also require the `elevation` attribute for `GeographicPointRepresentation`. [Mplify150 R2]

5.4. Model Structural Validation

The structure of the HTTP payloads exchanged via Address Validation API endpoints is defined using OpenAPI version 3.0.

[R18] Implementations **MUST** use payloads that conform to these definitions.

[R19] The Buyer and the Seller **MUST NOT** use any operation, entity or attribute that is not explicitly defined or allowed by this standard.

5.5. Security Considerations

There must be an authentication mechanism whereby a Seller can be assured who a Buyer is and vice-versa. There must also be authorization mechanisms in place to control what a particular Buyer or Seller is allowed to do and what information may be obtained. However, the definition of the exact security mechanism and configuration is outside the scope of this document. Security considerations are standardized by *LSO API Security Profile* [MEF 128.1].

6. API Interaction & Flows

This section provides a detailed insight into the API functionality, use cases, and flows. First, it presents a list of business use cases then provides examples with a comprehensive explanation of all usage aspects.

Use Case #	Use Case Name	Use Case Description
1	Geographic Address Validation	The Buyer sends to the Seller one or more Geographic Address Representations for a place known to them. The Seller responds with a list of Geographic Addresses known to them, which likely match information sent by the Buyer. For each Geographic Address returned, the Seller provides an Geographic Address Identifier, which uniquely identifies this Geographic Address within the Seller. The Seller may reply with an Immediate Response or a Deferred Response as directed by the Buyer. If the Buyer has stated that they would accept a Deferred Response, the Seller may still reply with an Immediate Response.
2	Retrieve Geographic Address Validation by Identifier	The Buyer requests the details of a Deferred Response to a Geographic Address Validation Request.
3	Retrieve Geographic Address by Identifier	The Buyer requests the details of a single Geographic Address based on an Geographic Address `id` that was previously provided by the Seller.
6	Register for Notifications	The Buyer registers for notifications on Geographic Address Validation requests that are Deferred.
7	Send Notification	The Seller generates notifications to Buyer's who have subscribed to notifications.

Table 5. Use cases description

[R20] The Buyer **MUST** be able to initiate Use Case 1 and 3. [Mplify150 R17], [Mplify150 R39]

[R21] The Seller **MUST** be able to provide either an Immediate Response or a Deferred Response for Use Case 1. [Mplify150 R19]

[R22] The Seller **MUST** associate an `id` to each unique Geographic Address of which they are aware. [Mplify150 R18]

[R23] If a Seller supports Deferred Response for the Validate Geographic Address request, the Seller **MUST** support Use Cases 2, 6, and 7. [Mplify150 R120]

[D1] For all Geographic Addresses that have not been validated, a Buyer **SHOULD** initiate a Validate Geographic Address request, to get the Seller's `GeographicAddress.id` and it's Representations. [Mplify150 D2]

[D2] For all Geographic Address that have been validated, the Buyer **SHOULD** use the Geographic Address `id` to reference the Geographic Address onwards. [Mplify150 D3]

6.1. Use case 1: Geographic Address Validation

Since there are often different representations of the same address, as an example 123 Main Street might be represented as 123 Main Street, 123 Main St, or 123 Main. The Buyer sends a request with the Geographic Address Representation(s) as they know it to the Seller and the Seller returns a list of `GeographicAddresses` (including the `id` for each) with possibly matching Representations that the Buyer can select from.

Each Geographic Address has an `id` within the Seller's system. If a Buyer submits an Geographic Address Validation request that does not directly match any of the Geographic Addresses existing in the Seller's system but the Seller knows other Geographic Addresses having (a) Geographic Address Representation(s) which are a close match, the Seller returns these Geographic Addresses as `alternateGeographicAddress` in the response. A close match is described as in the vicinity of, or close in Street Number, Street Name, etc. to the submitted Geographic Address Representation such as Buyer submits Street Number of 124, Seller knows Street Numbers 122 and 126 and returns them to the Buyer.

As another example of this, the Buyer submits a request to validate the Geographic Address represented as 123 Main St, Unit 8, Krakow, Poland. The Seller does not know this representation although they do know:

- 123 Main St, Krakow, Poland (`id=123`)
- 123 Main St, Unit 6, Krakow, Poland (`id=456`)
- 123 Main St, Unit 15, Krakow, Poland (`id=789`)

The Seller may approach this example in one of two ways. The first approach is that the Seller assumes that Unit 8 exists at 123 Main St, returns Unit 8 as the "best match", returns an Geographic Address Identifier to the Buyer, and may return the known Geographic Addresses as alternatives.

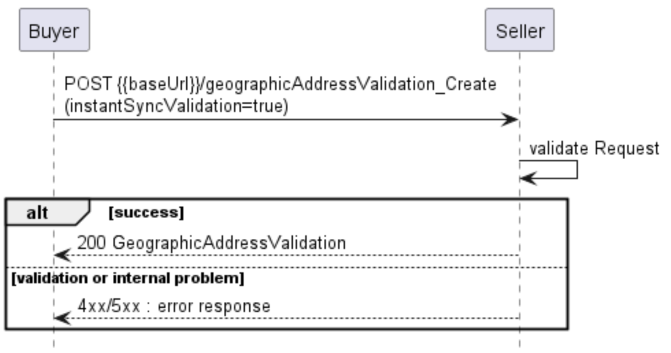
The second approach is that the Seller may determine that they do not know Unit 8 at 123 Main St and return one of the known Geographic Addresses as the "best match" or returns no "best match" and returns the known Geographic Addresses as alternatives. When the Geographic Address Validation process is completed, the Buyer knows how the Geographic Address is represented in the Seller's systems and has a Seller defined `id` of the Geographic Address.

Note: Address validation only verifies the way the Buyer needs to express the address to the Seller. It is not performed to verify that a particular product can be provided at that address.

To send a Validate Address request the Buyer uses the `createGeographicAddressValidation` operation from the API: `POST /geographicAddressValidation`.

There are 2 possible flows of this operation: immediate and deferred. The Buyer has an option to request an immediate response only, by providing `instantSyncValidation=true`. When the Buyer does not require an immediate response, the Seller can still provide one.

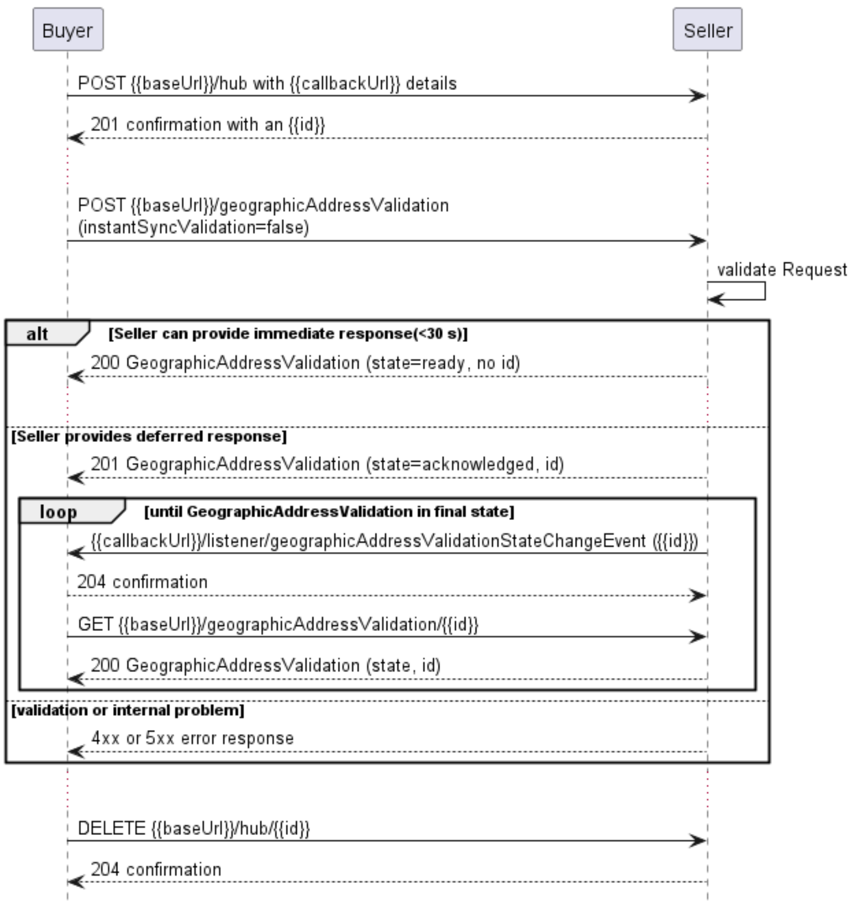
An immediate response flow is shown on Figure 7. The Seller provides full information in a synchronous response.



Buyer
Seller
POST {{baseUrl}}/geographicAddressValidation_Create (instantSyncValidation=true)
validate Request
alt
[success]
200 GeographicAddressValidation
[validation or internal problem]
4xx/5xx : error response

Figure 7. Geographic Address Validation immediate response

A deferred response flow is presented on Figure 8. The seller first acknowledges the request and then starts processing the validation. Whenever the `state` changes, an event is sent to the Buyer. The Buyer can than get the validation details.



Buyer
Seller
POST {{baseUrl}}/hub with {{callbackUrl}} details
201 confirmation with an {{id}}
POST {{baseUrl}}/geographicAddressValidation (instantSyncValidation=false)
validate Request
alt
[Seller can provide immediate response(<30 s)]
200 GeographicAddressValidation (state=ready, no id)
[Seller provides deferred response]
201 GeographicAddressValidation (state=acknowledged, id)
loop
[until GeographicAddressValidation in final state]
{{callbackUrl}}/listener/geographicAddressValidationStateChangeEvent ({{id}})
204 confirmation
GET {{baseUrl}}/geographicAddressValidation/{{id}}
200 GeographicAddressValidation (state, id)
[validation or internal problem]
4xx or 5xx error response
DELETE {{baseUrl}}/hub/{{id}}
204 confirmation

Figure 8. Geographic Address Validation deferred response

The lifecycle of a `GeographicAddressValidation` is shown on Figure 9:

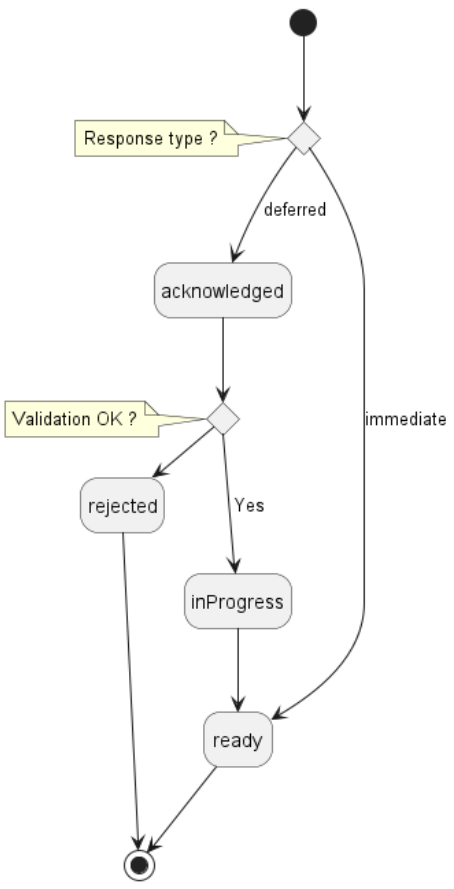


Figure 9. `GeographicAddressValidation` Lifecycle

Name	Description
acknowledged	A `GeographicAddressValidation` request has been received by the Seller and has passed basic validation. A `GeographicAddressValidation.id` is assigned in the `acknowledged` state and moves to `inProgress` when it passes business validation. If it does not pass business validation, it moves to the `rejected` state.
inProgress	The `GeographicAddressValidation` request is currently being worked on by the Seller.
ready	The `GeographicAddressValidation` request processing is completed and it is ready to be retrieved or the Immediate Response has been returned.
rejected	The `GeographicAddressValidation` request processing has failed at least one of the validation checks the Seller performs after it reached the `acknowledged` state.

Table 6. `GeographicAddressValidation` states

6.1.1 Geographic Address Validation - Request

The following snippet presents an example of a request using the `GeographicAddressValidation_Create:`

```
{
  "instantSyncValidation": false,
  "submittedGeographicAddress": {
    "@type": "GeographicAddress_Query",
    "fieldedAddressRepresentation": [
      {
        "streetName": "E. Wasilewskiego",
        "streetNr": "20",
        "city": "Cracow",
        "postcode": "30-305",
        "countryCode": "pl",
        "language": "en"
      }
    ],
    "geographicPointRepresentation": [
      {
        "spatialRef": "EPSG:4326",
        "latitude": "50.048868",
        "longitude": "19.929523"
      }
    ]
  }
}
```

In this example, the Buyer does not require only an immediate response (`"instantSyncValidation": false`) and provides 2 address representations - fielded and point. More representations potentially help the Seller to find the match for the address, especially in not urbanized areas.

It is expected that all Geographic Address Representations that are provided for a single validation request represent the same Geographic Address.

[R24] Buyer and Seller **MUST** agree what Geographic Address Representations may be included in the Geographic Address Validation request. [Mplify150 R1]

[R25] The Buyer **MUST** specify all attributes of the `FieldedAddressRepresentation` agreed with the Seller during on-boarding. [Mplify150 R24]

[R26] Following attributes **MUST** be provided when specifying `GeographicAddressValidation_Create`: [Mplify150 R22], [Mplify150 R23]

- `instantSyncValidation`
- `submittedGeographicAddress` - with at least one Representation

6.1.2 Geographic Address Validation Response

After receiving the request, the Seller validates its structure and completeness. When the validation of the request is successful, the Seller attempts to match the Buyer's provided Representations with Representations known in the Seller's address management system. For each Geographic Address that matches the `submittedGeographicAddress`, the Seller returns the address information including an identifier (`id`). It is up to the Seller to decide whether an Address matches the `submittedGeographicAddress`.

Having an Address validated does not provide any information of whether the Seller is able to provide any type of Product there. It only assures that the Buyer and Seller have a common understanding of the place and the Address to indicate that place. The validated address can then be used in further steps of the process.

The Seller responds with the `GeographicAddressValidation`:

```
{
  "state": "ready",
  "bestMatchGeographicAddress": {
    "@type": "GeographicAddress",
    "id": "00000000-0000-0030-0305-873500002000",
    "href": "{{baseUrl}}/geographicAddress/00000000-0000-0030-0305-873500002000",
    "allowsNewSite": "true",
    "hasPublicSite": "true",
    "fieldedAddressRepresentation": [
      {
        "streetType": "st.",
        "streetName": "Edmunda Wasilewskiego",
        "streetNr": "20",
        "city": "Cracow",
        "stateOrProvince": "Lesser Poland",
        "postcode": "30-305",
        "countryCode": "pl",
        "language": "en"
      }
    ],
    "geographicPointRepresentation": [
      {
        "spatialRef": "EPSG:4326",
        "latitude": "50.048868",
        "longitude": "19.929523"
      }
    ]
  },
  "alternateGeographicAddress": [
    {
      "@type": "GeographicAddress",
      "id": "00000000-0000-0030-0305-873500002010",
      "href": "{{baseUrl}}/geographicAddress/00000000-0000-0030-0305-873500002010",
      "allowsNewSite": "true",
      "hasPublicSite": "false",
      "fieldedAddressRepresentation": [
        {
          "streetType": "st.",
          "streetName": "Edmunda Wasilewskiego",
          "streetNr": "20",
          "city": "Cracow",
          "stateOrProvince": "Lesser Poland",
          "postcode": "30-305",
          "countryCode": "pl",
          "subUnit": [
            {
              "subUnitType": "floor",
              "subUnitNumber": "3"
            },
            {
              "subUnitType": "apartment",
              "subUnitNumber": "10"
            }
          ],
          "language": "en"
        }
      ],
      "geographicPointRepresentation": [
        {
          "spatialRef": "EPSG:4326",
          "latitude": "50.048868",
          "longitude": "19.929523"
        }
      ]
    },
    {
      "@type": "GeographicAddress",
      "id": "00000000-0000-0030-0305-873500002014",
      "href": "{{baseUrl}}/geographicAddress/00000000-0000-0030-0305-873500002014",
      "allowsNewSite": "true",
      "hasPublicSite": "true",
      "fieldedAddressRepresentation": [
        {
          "streetType": "st.",
          "streetName": "Edmunda Wasilewskiego",
          "streetNr": "20",
          "city": "Cracow",
          "stateOrProvince": "Lesser Poland",
          "postcode": "30-305",
          "countryCode": "pl",
          "subUnit": [
            {
              "subUnitType": "floor",
              "subUnitNumber": "4"
            },
            {
              "subUnitType": "apartment",
              "subUnitNumber": "14"
            }
          ],
          "language": "en"
        }
      ],
      "geographicPointRepresentation": [
        {
          "spatialRef": "EPSG:4326",
          "latitude": "50.048868",
          "longitude": "19.929523"
        }
      ]
    }
  ],
  "instantSyncValidation": false,
  "submittedGeographicAddress": {
    "@type": "GeographicAddress_Query",
    "fieldedAddressRepresentation": [
      {
        "streetName": "E. Wasilewskiego",
        "streetNr": "20",
        "city": "Cracow",
        "postcode": "30-305",
        "countryCode": "pl",
        "language": "en"
      }
    ],
    "geographicPointRepresentation": [
      {
        "spatialRef": "EPSG:4326",
        "latitude": "50.048868",
        "longitude": "19.929523"
      }
    ]
  }
}
```

Each of the returned Geographic Addresses, aside from representations, has the following attributes set:

- `id` and `href` to allow referencing them by the Buyer in later steps.
- `allowsNewSite` - to specify if a Buyer must use one of the known existing Service Sites at this location for any Products delivered to this Address.
- `hasPublicSite` - to specify if the Address contains Service Sites that are public (e.g. MeetMe-Rooms)

Having one or both of these attributes set to `false` doesn't mean that the Buyer cannot proceed with using the validated address in further steps.

The matched `fieldedAddressRepresentation` in Seller's system has more fields defined, thus the response contains more fields than in the Buyer's request. These are:

- `streetType`
- `subUnit`
- `stateOrProvince`
- `subUnit`

Additionally, the Seller has corrected 1 field to match the Seller's representation of the Address:

- `streetName`: from value `"E. Wasilewskiego"` to `"Edmunda Wasilewskiego"` the response contains a `bestMatchGeographicAddress` if found, and a list of `alternateGeographicAddress`, if any. In the example above the Seller decided to return the best match and 2 alternatives. That means that in the Seller's system 3 Addresses are matching the Buyer's Address representation (`countryCode`, `city`, `streetName`) out of which one was selected to be the best match.

While it is up to Seller's discretion to decide on what constitutes the best match and alternative, these rules are recommended:

- best match should be the address with the level of precision as provided in the request. In the example above the request provided a `streetName` and `streetNr` to point to a building. The Seller has three matching Addresses: one for the building and two for offices within it (one on 3rd floor, and on on 4th, all with same GPS coordinates). The Address of the building is chosen as the best match because the offices are more specific and additionally contain the `subUnit`.

- an Address of a different level of detail should be returned as an alternative one. Referring to the example - assuming there was no building address in Seller's system but only the addresses of the offices - the office addresses should all be marked as alternatives (even if the Seller by any reason prioritizes one over the other) because they additionally specify the `subUnit`. The same applies when matched Address would be of less detailed specification e.g. containing only `streetName` and no `streetNr`.

- the `alternateGeographicAddress` is not expected to be a sorted list.

The Seller may respond either with immediate or deferred response.

[R27] The Seller **MUST NOT** provide a deferred response if the Buyer has asked for an immediate response (`instantSyncValidation=true`). [Mplify150 R25]

[O3] The Seller **MAY** provide an immediate response regardless of the `instantSyncValidation` the Buyer has asked for. [Mplify150 O6]

[R28] The Seller **MUST** specify `state` when providing the response. [Mplify150 R27]

[R29] The Seller **MUST** return a HTTP Response Code `200` when providing an immediate response. [Mplify150 R27]

[R30] The Seller **MUST** return an HTTP Response Code `201` when providing a deferred response. [Mplify150 R27]

Note: The term "Seller Response Code" used in the Business Requirements maps to HTTP response code, where `2xx` indicates *Success* and `4xx` or `5xx` indicates *Failure*.

[R31] When the response is successful, the Seller **MUST** echo back all attributes received in the Buyer's request. [Mplify150 R29]

[R32] Following attributes **MUST** be provided when specifying the response: [Mplify150 R27], [Mplify150 R28]

- `state`
- per each `GeographicAddress` returned:
  - `id`
  - `allowsNewSite`
  - `hasPublicSite`
  - `@type`
  - at least one item in one of:

- `fieldedAddressRepresentation`
- `formattedAddressRepresentation`
- `geographicPointRepresentation`
- `labelRepresentation`

[R33] For an immediate response, the Seller **MUST** always provide `state=ready`. [Mplify150 R26]

[R34] For an immediate response, the Seller **MUST NOT** provide the `GeographicAddressValidation.id`.

[R35] For a deferred response, the Seller **MUST** provide the `GeographicAddressValidation.id`. [Mplify150 R35]

Note: For `allowsNewSite` and `hasPublicSite` attributes the `unknown` value means that either the Seller does not support Site Management, or they are not aware of whether the value is `true` or `false`.

[R36] In case of no matching addresses found, the Seller **MUST** return a successful response with no `bestMatchGeographicAddress` attribute and an empty list of `alternateGeographicAddress`.

[R37] If a `GeographicAddress` is identified and returned as a `bestMatchGeographicAddress` it **MUST NOT** be returned in `alternateGeographicAddress` list. [Mplify150 R32]

[R38] In case of too many matching addresses found (the definition of 'too many' is up to Seller's discretion), the Seller **MUST** return an `Error422` with `code=tooManyRecords`.

[R39] When validating the Geographic Address, the Seller **MUST** validate that the Geographic Address is within their Area of Validation. [Mplify150 R33]

[R40] When the Seller validates a Geographic Address that is not within their Area of Validation they **MUST** return a `422` Error with `code=otherIssue`, and a `reason` of e.g. *"Address out of Area of Validation"*. [Mplify150 R34]

Note: The Area of Validation coverage is up to the Seller's discretion. The Seller may decide to validate addresses regardless on where they are located and provide the serviceability context only at the Product Offering Qualification stage

6.2. Use case 2: Retrieve Geographic Address Validation by Identifier

This Use Case is performed to retrieve the details of Geographic Address Validation in case of a deferred response for use case 1. This is when the Seller is unable to perform validation of the Geographic Address within the time limits of an immediate response (suggested 30 seconds) and the Buyer is provided with an `GeographicAddressValidation.id` to identify the request. The Seller may also notify the Buyer whenever the `state` of the request changes (Use Case 7).

The sequence diagram for this use case is shown on Figure 10. It is also apart of a broader diagram presented on Figure 8.

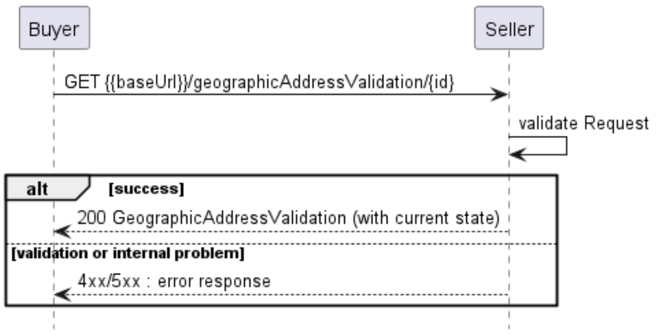

Buyer
Seller
GET {{baseUrl}}/geographicAddressValidation/{id}
validate Request
alt
[success]
200 GeographicAddressValidation (with current state)
[validation or internal problem]
4xx/5xx : error response

Figure 10. Retrieve Geographic Address Validation by Identifier Flow

The Buyer sends a Retrieve Geographic Address Validation by Identifier request using a `GET /geographicAddressValidation/{id}` operation.

[R41] The Seller response to the Retrieve Geographic Address Validation by Identifier request **MUST** include all of the `GeographicAddressValidation` attributes. [Mplify150 R37]

This may result in no `bestMatchGeographicAddress` and/or empty list of `alternateGeographicAddress` being returned if the Seller has not completed the validation process yet.

Sample request:

```
GET
/mefApi/sonata/geographicAddressManagement/v8/geographicAddressValidation/00000000-0000-4444-0305-873500004456
```

Sample response:

```
{
  "id": "00000000-0000-4444-0305-873500004456",
  "state": "inProgress",
  "alternateGeographicAddress": [
    {
      "@type": "GeographicAddress",
      "id": "00000000-0000-0030-0305-873500002014",
      "href": "{baseUrl}}/geographicAddress/00000000-0000-0030-0305-873500002014",
      "allowsNewSite": "true",
      "hasPublicSite": "true",
      "fieldedAddressRepresentation": [
        {
          "streetType": "st.",
          "streetName": "Edmunda Wasilewskiego",
          "streetNr": "20",
          "city": "Cracow",
          "stateOrProvince": "Lesser Poland",
          "postcode": "30-305",
          "countryCode": "pl",
          "subUnit": [
            {
              "subUnitType": "floor",
              "subUnitNumber": "4"
            },
            {
              "subUnitType": "apartment",
              "subUnitNumber": "14"
            }
          ],
          "language": "en"
        }
      ],
      "geographicPointRepresentation": [
        {
          "spatialRef": "EPSG:4326",
          "latitude": "50.048868",
          "longitude": "19.929523"
        }
      ]
    }
  ],
  "instantSyncValidation": false,
  "submittedGeographicAddress": {
    "@type": "GeographicAddress_Query",
    "fieldedAddressRepresentation": [
      {
        "streetName": "E. Wasilewskiego",
        "streetNr": "20",
        "city": "Cracow",
        "postcode": "30-305",
        "countryCode": "pl",
        "language": "en"
      }
    ],
    "geographicPointRepresentation": [
      {
        "spatialRef": "EPSG:4326",
        "latitude": "50.048868",
        "longitude": "19.929523"
      }
    ]
  }
}
```

[R42] In case `id` does not find a `GeographicAddressValidation` in Seller's system, an error response `404` **MUST** be returned.

6.3. Use case 3: Retrieve Geographic Address by Identifier

To get detailed and up do date information about the Geographic Address, the Buyer sends a Retrieve Geographic Address by Identifier request using a `GET /geographicAddress/{id}` operation.

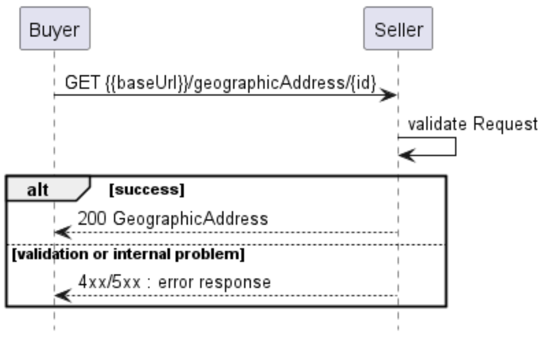


Figure 11. Retrieve Geographic Address by Identifier Flow

Sample request:

`GET /mefApi/sonata/geographicAddressManagement/v8/geographicAddress/00000000-0000-0030-0305-873500002000`

Sample response:

```
{
  "@type": "GeographicAddress",
  "id": "00000000-0000-0030-0305-873500002000",
  "href": "{baseUrl}}/geographicAddress/00000000-0000-0030-0305-873500002000",
  "allowsNewSite": "true",
  "hasPublicSite": "true",
  "fieldedAddressRepresentation": [
    {
      "streetType": "st.",
      "streetName": "Edmunda Wasilewskiego",
      "streetNr": "20",
      "city": "Cracow",
      "stateOrProvince": "Lesser Poland",
      "postcode": "30-305",
      "countryCode": "pl",
      "language": "en"
    }
  ],
  "geographicPointRepresentation": [
    {
      "spatialRef": "EPSG:4326",
      "latitude": "50.048868",
      "longitude": "19.929523"
    }
  ]
}
```

[R43] In case `id` does not find a `GeographicAddress` in Seller's system, an error response `404` **MUST** be returned.

[R44] The Seller **MUST** return all of the representations (of types agreed to by the Buyer and Seller) that the Seller is aware of when responding to the Retrieve Geographic Address by Identifier request. [Mplify150 R41]

[R45] Following attributes **MUST** be provided when specifying the response: [Mplify150 R42]

- `id`
- `hasPublicSite`
- `allowsNewSite`
- `@type`
- at least one item in one of:
  - `fieldedAddressRepresentation`
  - `formattedAddressRepresentation`
  - `geographicPointRepresentation`
  - `labelRepresentation`

6.4. Use case 6: Register for Notifications

When providing a deferred response, the Seller must support sending notifications. To receive these notifications, the Buyer needs to register for them.

6.4.1. Register for Notifications - Request

To register for notifications the Buyer uses the `registerListener` operation from the API: `POST /hub`. The request model contains only 2 attributes:

- `callback` - mandatory, to provide the callback address the events will be notified to,
- `query` - optional, to provide the required types of event.

[R46] The Buyer request **MUST** contain the following attributes: [Mplify150 R55]

- `callback`

By using a simple request:

```
{
  "callback": "https://buyer.mef.com/listenerEndpoint"
}
```

The Buyer subscribes for notification of all types of events.

If the Buyer wishes to receive only notification of a certain type, a `query` must be added:

```
{
  "callback": "https://buyer.mef.com/listenerEndpoint",
  "query": "eventType=geographicAddressValidationStateChangeEvent"
}
```

This Standard specifies only one type of event: `geographicAddressValidationStateChangeEvent` so the `query` parameter may be either empty or set to `eventType=geographicAddressValidationStateChangeEvent` and it will be equivalent.

The `query` formatting complies with RFC3986. According to which, every attribute defined in the Event model (from notification API) can be used in the `query`. However, this Mplify standard requires only `eventType` attribute to be supported.

[R47] `eventType` is the only attribute that the Seller **MUST** support in the `query`.

[R48] If the Seller does not support notifications, they **MUST** return an error message (`501`) to the Buyer indicating that notifications are not supported.

6.4.2. Register for Event Notifications - Response

The Seller responds to the subscription request by adding the `id` of the subscription to the message that must be further used for unsubscribing.

```
{
  "callback": "https://buyer.mef.com/listenerEndpoint",
  "id": "1659bc83-d334-4de4-aa60-0818e4060ae1",
  "query": "eventType=geographicAddressValidationStateChangeEvent"
}
```

Example of a final address that the Notifications will be sent to (for Sonata, `geographicAddressValidationStateChangeEvent`):

- `https://buyer.mef.com/listenerEndpoint/mefApi/sonata/geographicAddressValidationNotifications/v8/listener/geographicAddressValidationStateChangeEvent`

6.4.3. Unregister from Event Notifications - Request

To stop receiving notifications, the Buyer has to use the `unregisterListener` operation from the `DELETE /hub/{id}` endpoint. The `id` is the identifier received from the Seller during the registration.

[R49] The Buyer must provide the `id` of the registered `EventSubscription` that originates from the Seller.

The example below shows an exemplary unregister call sent by the Buyer to the Seller:

```
http://seller.mef.com:8080/mefApi/sonata/geographicAddress/v8/hub/1659bc83-d334-4de4-aa60-0818e4060ae1
```

6.4.4. Unregister for Event Notifications - Response

[R50] In the successful scenario the Seller **MUST** respond with an empty body and HTTP code `204`.

The Buyer can unregister only the whole `EventSubscription`, regardless of the provided `query`. In the case when the Buyer e.g. resigns from specific types of events (or changes the callback address), the existing `EventSubscription` that includes undesired notification types needs to be removed and replaced by the new `EventSubscription` with adjusted `query` attribute.

Note: The above note concludes that the Buyer cannot update the existing `EventSubscription`. Every kind of update is done by subscription replacement.

6.5. Use case 7: Send Notifications

Notifications are used to asynchronously inform the Buyer about the respective objects and attributes changes.

[R51] The Seller **MUST** send Notifications for `eventTypes` to Buyers who have registered for them. [Mplify150 R57]

[R52] The Seller **MUST NOT** send Notifications for `eventTypes` to Buyers who have not registered for them. [Mplify150 R58]

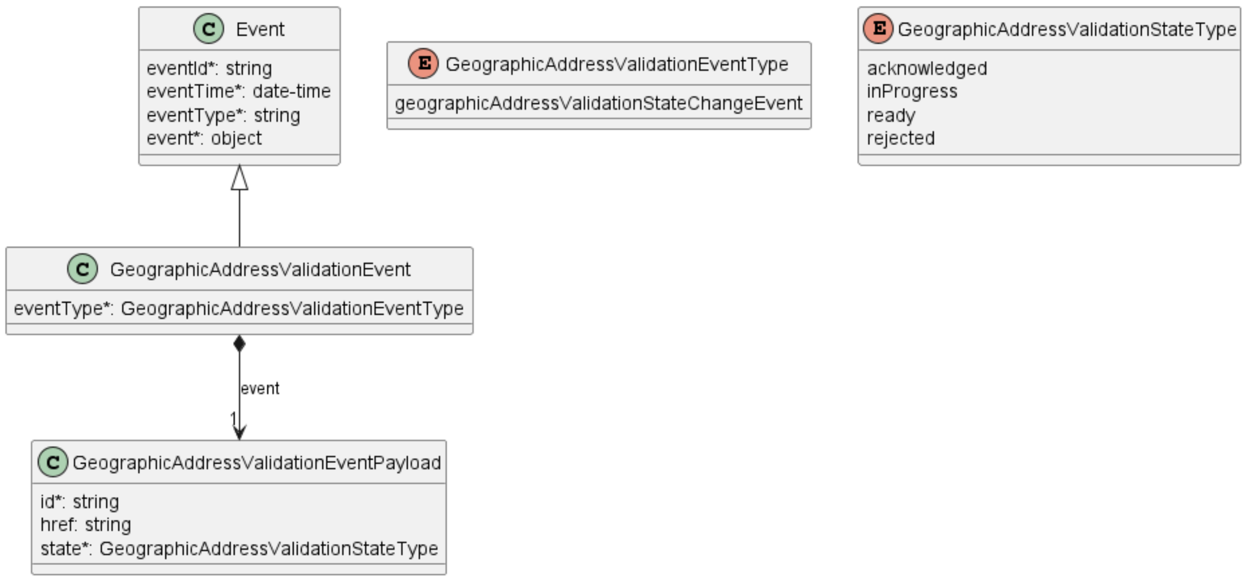
[R53] The Seller **MUST** send a notification to all of the targets specified by the Buyer every time there is a change in state. [Mplify150 R60]

[O4] If the Seller fails to receive an acknowledgment from the Buyer repeatedly then Seller **MAY** mark related `EventSubscription` as corrupted and stop sending notifications.

[CR1]<[O4] If the Seller marked related `EventSubscription` as corrupted then unsent notifications **MUST** be stored as dead letters for resending purposes.

It's at the Buyer and Seller's discretion how to inform the Buyer that the listener is out of service and how to uncheck corrupted `EventSubscription` when the listener is claimed.

Figure 12 shows all entities involved in the Send Notification use case.



Event
eventId*: string
eventTime*: date-time
eventType*: string
event*: object
GeographicAddressValidationEventType
geographicAddressValidationStateChangeEvent
GeographicAddressValidationStateType
acknowledged
inProgress
ready
rejected
GeographicAddressValidationEvent
eventType*: GeographicAddressValidationEventType
event
1
GeographicAddressValidationEventPayload
id*: string
href: string
state*: GeographicAddressValidationStateType

Figure 12. Notification Data Model

The following snippet presents an example of `geographicAddressValidationStateChangeEvent`

```
{
  "eventId": "44b691d1-771a-44b6-1695-050dd415771a",
  "eventTime": "2024-08-06T15:58:51.968Z",
  "eventType": "geographicAddressValidationStateChangeEvent",
  "event": {
    "id": "f277fbed-2328-891d-8801-b1e4ce388801",
    "state": "inProgress"
  }
}
```

[R54] The Seller **MUST** provide the following attributes of `GeographicAddressValidationStateChangeEventPayload` when sending `GeographicAddressValidationStateChangeEvent`:

- `id`
- `state`

The body of the event carries only the source object's `id`. The Buyer needs to query it later by `id` to get details.

Note: Object creation is not considered a "state change" type of the event. Thus, there are no notifications sent when the response is immediate.

7. API Details

7.1. API patterns

7.1.1. Indicating errors

Erroneous situations are indicated by appropriate HTTP responses. An error response is indicated by HTTP status 4xx (for client errors) or 5xx (for server errors) and appropriate response payload. The Address Validation API uses the error responses depicted and described below.

Implementations can use http error codes not specified in this standard in compliance with rules defined in RFC 7231 [RFC7231]. In such case the error message body structure might be aligned with the `Error`.

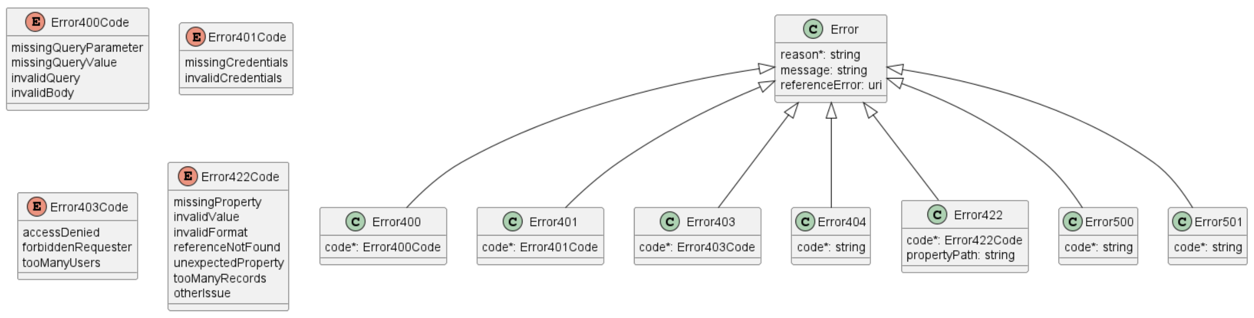


Figure 13. Data model types to represent an erroneous response

7.1.1.1. Type Error

Description: Standard Class used to describe API response error Not intended to be used directly. The `code` in the HTTP header is used as a discriminator for the type of error returned in runtime.

Name	Type	Description
reason*	string *maxLength = 255*	Text that explains the reason for error. This can be shown to a client user.
message	string	Text that provides mode details and corrective actions related to the error. This can be shown to a client user.
referenceError	uri *format = uri*	URL pointing to documentation describing the error

7.1.1.2. Type Error400

Description: Bad Request. (https://tools.ietf.org/html/rfc7231#section-6.5.1)

Inherits from:

- Error

Name	Type	Description

Name	Type	Description
code*	Error400Code	One of the following error codes: - missingQueryParameter: The URI is missing a required query-string parameter - missingQueryValue: The URI is missing a required query-string parameter value - invalidQuery: The query section of the URI is invalid. - invalidBody: The request has an invalid body

7.1.1.3. `enum` Error400Code

Description: One of the following error codes:

- missingQueryParameter: The URI is missing a required query-string parameter
- missingQueryValue: The URI is missing a required query-string parameter value
- invalidQuery: The query section of the URI is invalid.
- invalidBody: The request has an invalid body

7.1.1.4. Type Error401

Description: Unauthorized. (https://tools.ietf.org/html/rfc7235#section-3.1)

Inherits from:

- Error

Name	Type	Description
code*	Error401Code	One of the following error codes: - missingCredentials: No credentials provided. - invalidCredentials: Provided credentials are invalid or expired

7.1.1.5. `enum` Error401Code

Description: One of the following error codes:

- missingCredentials: No credentials provided.
- invalidCredentials: Provided credentials are invalid or expired

7.1.1.6. Type Error403

Description: Forbidden. (https://tools.ietf.org/html/rfc7231#section-6.5.3)

Inherits from:

- Error

Name	Type	Description
code*	Error403Code	This code indicates that the server understood the request but refuses to authorize it because of one of the following error codes: - accessDenied: Access denied - forbiddenRequester: Forbidden requester - tooManyUsers: Too many users

7.1.1.7. `enum` Error403Code

Description: This code indicates that the server understood the request but refuses to authorize it because of one of the following error codes:

- accessDenied: Access denied
- forbiddenRequester: Forbidden requester
- tooManyUsers: Too many users

7.1.1.8. Type Error404

Description: Resource for the requested path not found. (https://tools.ietf.org/html/rfc7231#section-6.5.4)

Inherits from:

- Error

Name	Type	Description
code*	string	The following error code: - notFound: A current representation for the target resource not found

7.1.1.9. Type Error422

The response for HTTP status `422` is a list of elements that are structured using the `Error422` data type. Each list item describes a business validation problem. This type introduces the `propertyPath` attribute which points to the erroneous property of the request, so that the Buyer may fix it easier. It is highly recommended that this property should be used, yet remains optional because it might be hard to implement.

Description: Unprocessable entity due to a business validation problem. (https://tools.ietf.org/html/rfc4918#section-11.2)

Inherits from:

- Error

Name	Type	Description
code*	Error422Code	One of the following error codes: - missingProperty: The property the Seller has expected is not present in the payload - invalidValue: The property has an incorrect value - invalidFormat: The property value does not comply with the expected value format - referenceNotFound: The object referenced by the property cannot be identified in the Seller system - unexpectedProperty: Additional property, not expected by the Seller has been provided - tooManyRecords: the number of records to be provided in the response exceeds the Seller's threshold. - otherIssue: Other problem was identified (detailed information provided in a reason)

Name	Type	Description
propertyPath	string	A pointer to a particular property of the payload that caused the validation issue. It is highly recommended that this property should be used. Defined using JavaScript Object Notation (JSON) Pointer (https://tools.ietf.org/html/rfc6901).

7.1.1.10. `enum` Error422Code

Description: One of the following error codes:

- missingProperty: The property the Seller has expected is not present in the payload
- invalidValue: The property has an incorrect value
- invalidFormat: The property value does not comply with the expected value format
- referenceNotFound: The object referenced by the property cannot be identified in the Seller system
- unexpectedProperty: Additional property, not expected by the Seller has been provided
- tooManyRecords: the number of records to be provided in the response exceeds the Seller's threshold.
- otherIssue: Other problem was identified (detailed information provided in a reason)

7.1.1.11. Type Error500

Description: Internal Server Error. (https://tools.ietf.org/html/rfc7231#section-6.6.1)

Inherits from:

- Error

Name	Type	Description
code*	string	The following error code: - internalError: Internal server error - the server encountered an unexpected condition that prevented it from fulfilling the request.

7.1.1.12. Type Error501

Description: Not Implemented. Used in case Seller is not supporting an optional operation (https://tools.ietf.org/html/rfc7231#section-6.6.2)

Inherits from:

- Error

Name	Type	Description
code*	string	The following error code: - notImplemented: Method not supported by the server

7.2. API Data model

Figure 14 presents the Address Validation data model. The data types, requirements related to them, and mapping to Mplify 150 specification are discussed later in this section.

This data model is used to construct requests and responses of the API endpoints described in Section 5.2.1

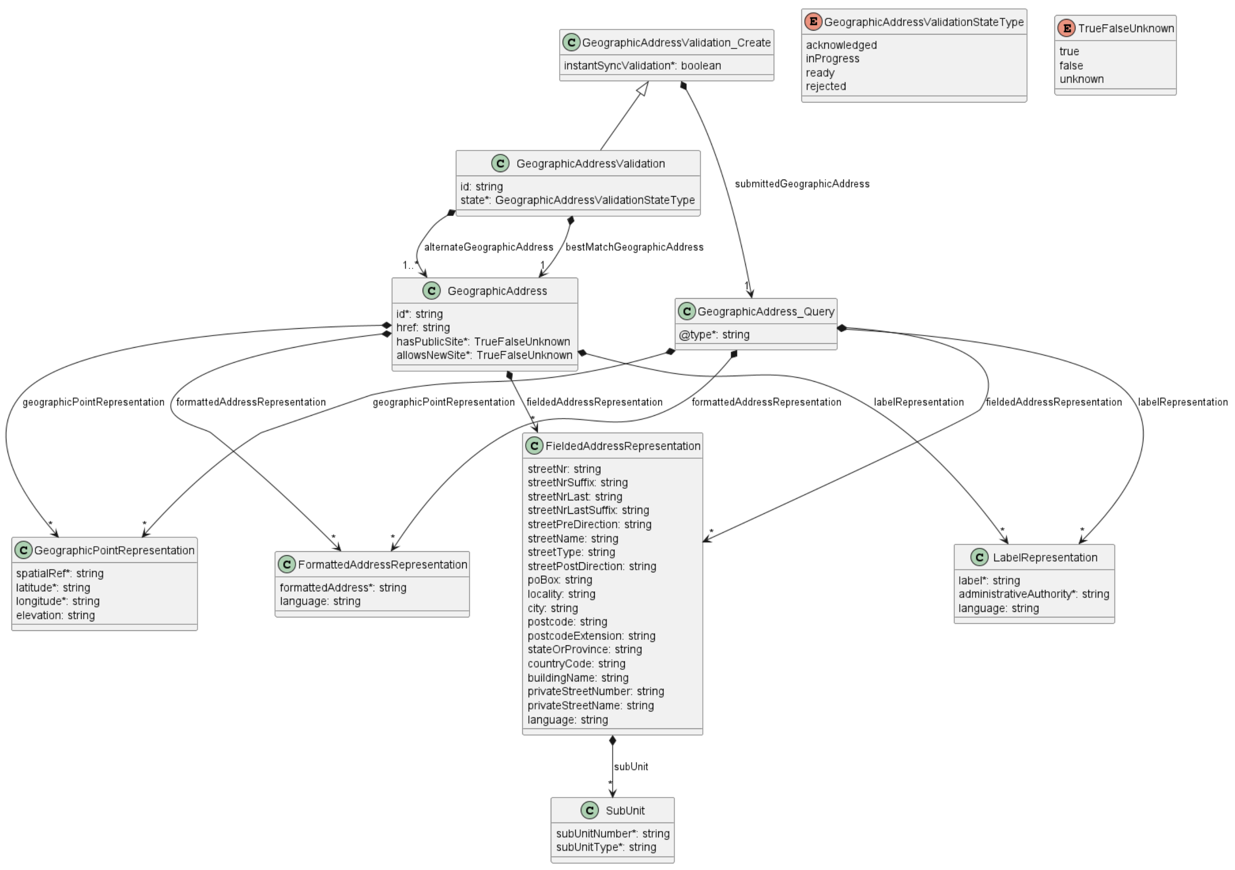

GeographicAddressValidation_Create
instantSyncValidation*: boolean
GeographicAddressValidationStateType
acknowledged
inProgress
ready
rejected
TrueFalseUnknown
true
false
unknown
GeographicAddressValidation
id: string
state*: GeographicAddressValidationStateType
submittedGeographicAddress
alternateGeographicAddress
bestMatchGeographicAddress
GeographicAddress
id*: string
href: string
hasPublicSite*: TrueFalseUnknown
allowsNewSite*: TrueFalseUnknown
GeographicAddress_Query
@type*: string
geographicPointRepresentation
formattedAddressRepresentation
fieldedAddressRepresentation
labelRepresentation
FieldedAddressRepresentation
streetNr: string
streetNrSuffix: string
streetNrLast: string
streetNrLastSuffix: string
streetPreDirection: string
streetName: string
streetType: string
streetPostDirection: string
poBox: string
locality: string
city: string
postcode: string
postcodeExtension: string
stateOrProvince: string
countryCode: string
buildingName: string
privateStreetNumber: string
privateStreetName: string
language: string
GeographicPointRepresentation
spatialRef*: string
latitude*: string
longitude*: string
elevation: string
FormattedAddressRepresentation
formattedAddress*: string
language: string
LabelRepresentation
label*: string
administrativeAuthority*: string
language: string
subUnit
SubUnit
subUnitNumber*: string
subUnitType*: string

Figure 14. Address Validation Data Model

7.2.1 Geographic Address Validation

7.2.1.1 Type GeographicAddressValidation_Create

Description: This resource is used to manage address validation requests.

Name	Type	M/O	Description	Mplify 150
submittedGeographic-Address	GeographicAddress_-Query	M	Structure used by the buyer to request geographic address validation'	Buyer Specified Address
instantSyncValidation	boolean	M	If this flag is set to True, the Buyer requires an Immediate Response to this request. If the Seller is unable to provide an Immediate Response, the Seller is to reply with an appropriate error.	Immediate Response Only

7.2.1.2 Type GeographicAddressValidation

Description: This resource is used to manage address validation response.

Inherits from:

- GeographicAddressValidation_Create

Name	Type	M/O	Description	Mplify 150
id	string	O	An identifier that the Seller assigns to the Validate Geographic Address request when the response is Deferred.	Validate Installation Place Request Identifier
state	GeographicAddress-ValidationStateType	M	The state of a GeographicAddressValidation.	Validate Installation Place Request State
alternate-GeographicAddress	GeographicAddress[]	M	An array of zero or more GeographicAddresses known to the Seller that are considered by the Seller to be an alternate to the Buyer's `submittedGeographicAddress`	Seller Verified Alternate Installation Place(s)
bestMatch-GeographicAddress	GeographicAddress	O	Specifies the GeographicAddress which the Seller believes is the best match to the Buyer's `submittedGeographicAddress`.	Seller Verified Best Match Installation Place

7.2.1.3 `enum` GeographicAddressValidationStateType

Description: A list of possible `state` values for GeographicAddressValidation.

Name	Description
acknowledged	A GeographicAddressValidation request has been received by the Seller and has passed basic validation. A `GeographicAddressValidation.id` is assigned in the `acknowledged` state and moves to `inProgress` when it passes business validation. If it does not pass business validation, it moves to the `rejected` state.
inProgress	The GeographicAddressValidation request is currently being worked on by the Seller.
ready	The GeographicAddressValidation processing is completed by the Seller and it is ready to be retrieved or the Immediate Response has been returned.
rejected	The GeographicAddressValidation processing has failed at least one of the validation checks the Seller performs after it reached the `acknowledged` state.

Value	Mplify 150

Value	Mplify 150
acknowledged	ACKNOWLEDGED
inProgress	IN_PROGRESS
ready	READY
rejected	REJECTED

7.2.2. Geographic Address

7.2.2.1 Type GeographicAddress_Query

Description: A list of representations being a subset of Geographic Address entity. This is to be used when providing a list of representations to validate or search for a Geographic Address

Name	Type	M/O	Description	Mplify 150
fieldedAddress-Representation	FieldedAddress-Representation[]	O	A list of Fielded Address representations	Installation Place Representations
formattedAddress-Representation	FormattedAddress-Representation[]	O	A list of Formatted Address representations	Installation Place Representations
geographicPoint-Representation	GeographicPoint-Representation[]	O	A list of Geographic Point Address representations	Installation Place Representations
label-Representation	Label-Representation[]	O	A list of Label Address representations	Installation Place Representations
@type	string	M	Used to unambiguously designate the class type when using `oneOf`	Not represented in Mplify 150

7.2.2.2 Type GeographicAddress

Description: A place on Earth, which may or may not be fixed, described using one or more Geographic Address Representations.

Name	Type	M/O	Description	Mplify 150
id	string	M	Unique identifier of the place	Geographic Address Identifier
href	string	O	Unique reference of the place	Not represented in Mplify 150
hasPublicSite	TrueFalseUnknown	M	This attribute specifies if public sites exist at the GeographicAddress	Installation Place Has Public Sites

Name	Type	M/O	Description	Mplify 150
allowsNewSite	TrueFalseUnknown	M	This attribute specifies if a Buyer must use one of the known existing Sites at this location for any Products delivered to this Address.	Installation Place Allows New Sites
fieldedAddress-Representation	FieldedAddress-Representation[]	O	A list of Fielded Address representations	Installation Place Representations
formattedAddress-Representation	FormattedAddress-Representation[]	O	A list of Formatted Address representations	Installation Place Representations
geographicPoint-Representation	GeographicPoint-Representation[]	O	A list of Geographic Point Address representations	Installation Place Representations
label-Representation	Label-Representation[]	O	A list of Label Address representations	Installation Place Representations
@type	string	M	Used to unambiguously designate the class type when using `oneOf`	Not represented in Mplify 150

7.2.2.3. Type FieldedAddressRepresentation

Description: A type of Address that has a discrete field and value for each type of boundary or identifier down to the lowest level of detail. For example "street number" is one field, "street name" is another field, etc.

Name	Type	M/O	Description	Mplify 150
streetNr	string	O	Number identifying a specific property on a public street. It may be combined with streetNrLast for ranged addresses.	Street Number
streetNrSuffix	string	O	The first street number suffix (in a street number range) or the suffix for the street number if there is no range	Street Number Suffix
streetNrLast	string	O	Last number in a range of street numbers allocated to an Address	Street Number Last
streetNrLastSuffix	string	O	Last street number suffix for a ranged Address	Street Number Last Suffix

Name	Type	M/O	Description	Mplify 150
streetPreDirection	string	O	The direction of the street that appears before the Street Name	Street Pre-Direction
streetName	string	O	Name of the street or other street type	Street Name
streetType	string	O	The type of street (e.g., alley, avenue, boulevard, brae, crescent, drive, highway, lane, terrace, parade, place, tarn, way, wharf)	Street Type
streetPostDirection	string	O	A modifier denoting a relative direction that appears after the Street Name.	Street Post-Direction
poBox	string	O	Number identifying a specific location in a post office.	PO Box Number
locality	string	O	An area of defined or undefined boundaries within a local authority or other legislatively defined area.	Locality
city	string	O	City in which the Address is located.	City
postcode	string	O	A descriptor for a postal delivery area used to speed and simplify the delivery of mail (also known as zip code)	Postal Code
postcodeExtension	string	O	The extension used on a postal code. Note: there are different use codes for this attribute depending upon the country.	Postal Code Extension
stateOrProvince	string	O	The State or Province in which the Address is located.	State or Province
countryCode	string *minLength = 2* *maxLength = 2*	O	Country in which the Address is located, defined using two characters as defined in ISO 3166	Country
subUnit	SubUnit[]	O	The Sub Unit represented as a list. This is a list to allow complex sub-unit information such as SUITE 42 ROOM A	Sub Units
buildingName	string	O	The well-known name of a building that is located at this Address (e.g., where there is one Address for a campus).	Building Name
privateStreetNumber	string	O	Street number on a private street within the Address.	Private Street Number

Name	Type	M/O	Description	Mplify 150
privateStreetName	string	O	Private streets internal to a property (e.g., a university) may have internal names that are not recorded by the land title office.	Private Street Name
language	string *minLength = 2* *maxLength = 2*	O	The language in which the address is expressed. It MUST use the ISO 639:2023 two letter code 639:2023	Language

7.2.2.4. Type FormattedAddressRepresentation

Description: A type of Representation using single string based on local postal addressing conventions.

Name	Type	M/O	Description	Mplify 150
formattedAddress	string	M	A string containing the address representation	Formatted Address
language	string *minLength = 2* *maxLength = 2*	O	The language in which the address is expressed. It MUST use the ISO 639:2023 two letter code	Language

7.2.2.5. Type GeographicPointRepresentation

Description: A type of Representation where coordinates (latitude, longitude and sometimes elevation) are used to specify a particular place on Earth.

Name	Type	M/O	Description	Mplify 150
spatialRef	string	M	The spatial reference system used to determine the coordinates. The system used and the value of this field are to be agreed during the onboarding process.	Spatial Reference
latitude	string	M	The latitude expressed in the format specified by the \`spacialRef\`	Latitude
longitude	string	M	The longitude expressed in the format specified by the \`spacialRef\`	Longitude
elevation	string	O	The elevation expressed in the format specified by the \`spacialRef\`	Elevation

7.2.2.6. Type LabelRepresentation

Description: A type of Geographic Address Representation that is a unique combination of label and Administrative Authority (any organization that distributes labels) that controls assignment of the label and that specifies either a place which may or may not be fixed on Earth.It can be used to identify things that do not have a static Address, such as airplanes or ships

Name	Type	M/O	Description	Mplify 150
label	string	M	The unique reference to an Geographic Address assigned by the Administrative Authority.	Installation Place Label
administrativeAuthority	string	M	The organization or standard from the organization that administers this Label ensuring it is unique within the Administrative Authority.	Administrative Authority
language	string *minLength = 2* *maxLength = 2*	O	The language in which the label is expressed. It MUST use the ISO 639:2023 two letter code'	Language

7.2.2.7. Type SubUnit

Description: Allows for sub unit identification

Name	Type	M/O	Description	Mplify 150
subUnitNumber	string	M	The discriminator used for the subunit, often just a simple number but may also be a range.	Sub Unit Name
subUnitType	string	M	The type of subunit e.g. BERTH, FLAT, PIER, SUITE, SHOP, TOWER, UNIT, WHARF.	Sub Unit Type

7.2.2.8. `enum` TrueFalseUnknown

Description: An enumeration used to represent one of three states

Value	Mplify 150
true	TRUE
false	FALSE
unknown	UNKNOWN

7.2.3. Notification registration

Notification registration and management are done through `/hub` API endpoint. The below sections describe data models related to this endpoint.

7.2.3.1. Type EventSubscriptionInput

Description: This class is used to register for Notifications.

Name	Type	M/O	Description	Mplify 150
callback	string	M	The callback address that the Buyer will be listening for the event notifications at. This property is appended with the notification resource path to construct an URL to which notification is sent. E.g. for "callback": "https://buyer.mef.com/listenerEndpoint", the Geographic Address Validation State Change Event state change notification will be sent to: `https://buyer.mef.com/listenerEndpoint /mefApi/sonata/geographicAddressNotification /v8/listener/geographicAddressValidationStateChangeEvent`	Return Address Information
query	string	O	This attribute is used to define to which type of events to register to. There is only one event type possible, so the value must either be empty or equal to " geographicAddressValidationStateChangeEvent".	List of Notification Types, Action

7.2.3.2. Type EventSubscription

Description: This resource is used to respond to notification subscriptions.

Name	Type	M/O	Description	Mplify 150
callback	string	M	The value provided by the Buyer in `EventSubscriptionInput` during notification registration	Return Address Information
id	string	M	An identifier of this Event Subscription assigned by the Seller when a resource is created.	Not represented in Mplify 150
query	string	O	The value provided by the Buyer in `EventSubscriptionInput` during notification registration	List of Notification Types, Action

7.3. Notification API Data model

7.3.1. Type Event

Description: Event class is used to describe information structure used for notification.

Name	Type	M/O	Description	Mplify 150
eventId	string	M	Id of the event	Not represented in Mplify 150
eventTime	date-time *format = date-time*	M	Date-time when the event occurred	Not represented in Mplify 150
eventType	string	M	The type of the notification.	Notification Type
event	object	M	The event linked to the involved resource object	State, Validate Installation Place Identifier

7.3.2. Type GeographicAddressValidationEvent

Description:

Inherits from:

- Event

Name	Type	M/O	Description	Mplify 150
eventType	string	M	Indicates the type of the event.	Notification Type
event	GeographicAddressValidation-EventPayload	M	A reference to the Geographic Address Validation that is source of the notification.	State, Validate Installation Place Identifier

7.3.3. Type GeographicAddressValidationEventPayload

Description: The identifier of the Geographic Address Validation being subject of this event.

Name	Type	M/O	Description	Mplify 150
id	string	M	ID of the Geographic Address Validation	Validate Installation Place Identifier
href	string	O	Hyperlink to access the Geographic Address Validation	Not represented in Mplify 150
state	GeographicAddressValidation-StateType	M	A state reached at change date	State

8. References

- [ISO 639:2023], Code for individual languages and language groups, November 2023
- [ISO 3166], Codes for the representation of names of countries and their subdivisions - Part 1: Country code, 2020
- MEF 50.1, MEF Services Lifecycle Process Flows, August 2017.
- MEF 55.1, Lifecycle Service Orchestration (LSO): Reference Architecture and Framework, February 2021
- MEF 55.1.1, Amendment to MEF 55.1: Reference Architecture and Framework - Terminology, June 2023
- MEF 128.1, LSO API Security Profile, April 2024
- Mplify 150, Installation Place and Service Site Management Business Requirements and Use Cases, June 2025
- Open API 3.0, February 2020
- REST Fielding, Roy Thomas, Architectural Styles and the Design of Network-based Software Architectures (Ph.D.).
- RFC 2119, Key words for use in RFCs to Indicate Requirement Levels, March 1997
- RFC 3986, Uniform Resource Identifier (URI): Generic Syntax, January 2005
- RFC 7231, Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content, June 2014
- RFC 8174, Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words, May 2017
- TMF 673, TMF673 Geographic Address Management API User Guide v4.0.0

Appendix A Acknowledgments

Mike **BENCHECK**

Tomasz **CHMAL**

Pankaj **BODADE**

Michał **ŁĄCZYŃSKI**

Jack **PUGACZEWSKI**

Patrick **ROOSEN**

Fahim **SABIR**