Mplify Standard

Mplify 116.1

LSO Cantata and LSO Sonata Product Inventory API - Developer Guide

November 2025

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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.

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Table 1. Contributing Members

1. Abstract

This standard assists the implementation of the Product Inventory functionality defined for the LSO Cantata and LSO Sonata Interface Reference Points (IRPs), for which requirements and use cases are defined in MEF 81 *Product Inventory Management Requirements and Use Cases* [MEF 81] and MEF 81.0.1 *Amendment to MEF 81: Product Inventory Management* [MEF 81.0.1]. This standard consists of this document and complementary API definition.

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/inventory/productInventoryManagement.api.yaml`

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

commit id: 83d6edd0c70386058a9af6e677c069b498671da7

- `productApi/inventory/productInventoryManagement.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 55.1
- MEF 55.1.1
- Mplify 150

Term	Description	Reference
Application Program Interface (API)	In the context of LSO, API describes one of the Management Interface Reference Points based on the requirements specified in an Interface Profile, along with a data model, the protocol that defines operations on the data and the encoding format used to encode data according to the data model. In this document, API is used synonymously with REST API.	[MEF 55.1]
Buyer	In the context of this document, denotes the organization or individual acting as the customer in a transaction over a Cantata (Customer <-> Service Provider) or Sonata (Service Provider <-> Partner) Interface.	This document; adapted from [MEF 55.1.1]
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]
Seller	In the context of this document, denotes the organization acting as the supplier in a transaction over a Cantata (Customer <-> Service Provider) or Sonata (Service Provider <-> Partner) Interface.	This document; adapted from [MEF 55.1.1]

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 ([RFC 2119], [RFC 8174]) when, and only when, they appear in all capitals, as shown here. All keywords 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

This standard specification document describes the Application Programming Interface (API) for Product Inventory functionality of the LSO Cantata Interface Reference Point (IRP) and LSO Sonata 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 with both IRPs highlighted.

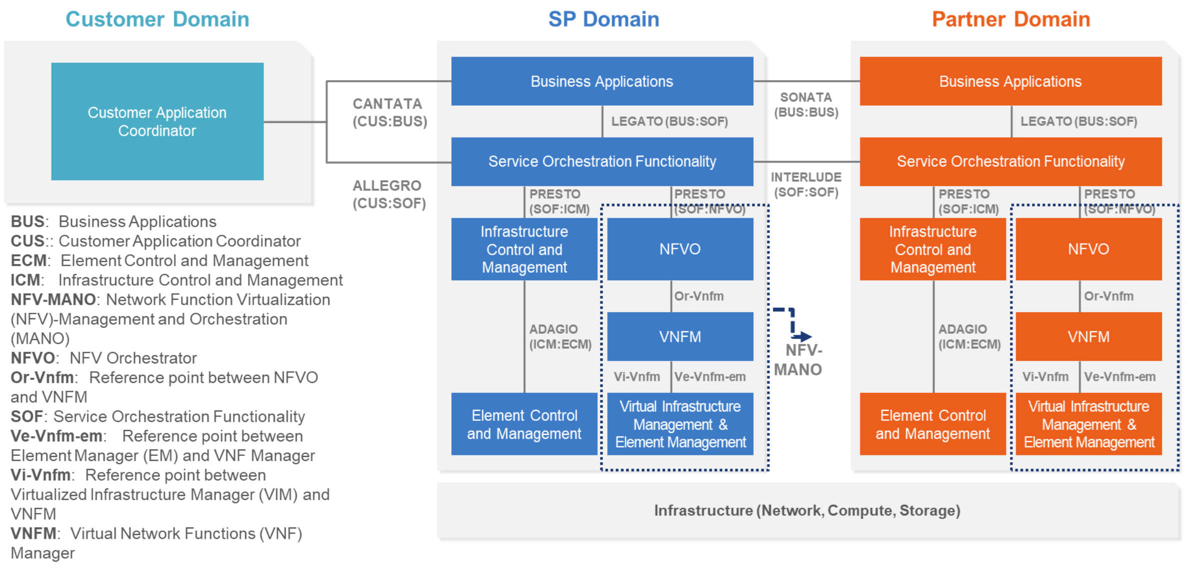

Customer Domain
SP Domain
Partner Domain
Customer Application Coordinator
CANTATA (CUS:BUS)
ALLEGRO (CUS:SOF)
Business Applications
LEGATO (BUS:SOF)
Service Orchestration Functionality
PRESTO (SOF:ICM)
PRESTO (SOF:NFVO)
Infrastructure Control and Management
NFVO
Or-Vnfm
ADAGIO (ICM:ECM)
VNFM
Vi-Vnfm
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 (Partner) Domains. Those are:

- Product Catalog
- Address Validation
- Site Retrieval
- Product Offering Qualification
- Product Quote
- Product Inventory
- Product Ordering
- Trouble Ticketing
- Billing

This document focuses on implementation aspects and is structured as follows:

- Chapter 4 provides an introduction to Product Inventory 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. Description

The Product Inventory API allows the Buyer to retrieve information about existing (previously ordered) Products from the Seller's Inventory. The Seller's Product Inventory is a set of instances of Products that have been ordered by a Buyer. It is assumed, for a Product to exist in the Seller's Product Inventory, that the Seller has passed the `Product.id` to the Buyer per Mplify 57.2.

The API payloads exchanged between the Buyer and the Seller consist of product-independent and product-specific parts. The product-independent part is technically defined in this standard. The product-specific part is defined in the product specification standard of the concerned product. Both standards must be used in combination to validate the correctness of the payloads. Section 5.4 explains how to use product specifications as the Inventory API payloads.

4.2. 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. `Product`).
- 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.

4.3. Relation to Other Documents

The requirements and use cases for Product Inventory Management are defined in [MEF 81] and [MEF 81.0.1]. The API definition builds on *TMF637 Product Inventory Management API REST Specification R19.0.0* [TMF 637].

Product specifications are defined using JSON Schema (draft 7) standard [JSON], whereas Quote API is defined using OpenAPI 3.0 [OAS-V3]. The payloads exchanged through Quote endpoints must comply with respective Product Specifications.

4.4. Approach

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)

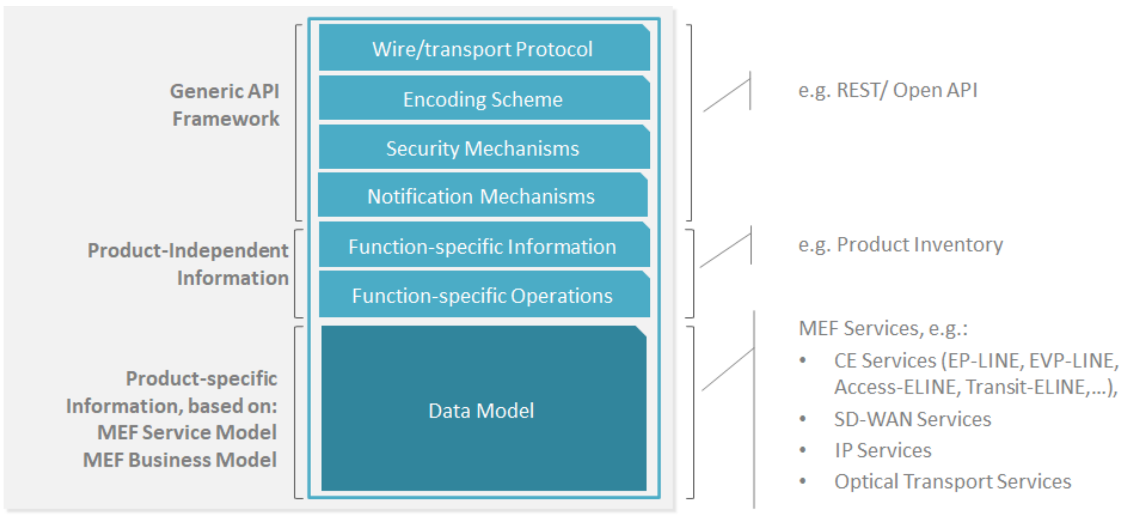

Generic API Framework
Product-Independent Information
Product-specific Information, based on: MEF Service Model MEF Business Model
Wire/transport Protocol
Encoding Scheme
Security Mechanisms
Notification Mechanisms
Function-specific Information
Function-specific Operations
Data Model
e.g. REST/ Open API
e.g. Product Inventory
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. For example, this standard describes the Quote model and operations that allow performing quoting of any product that is aligned with either Mplify or custom 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.

This Developer Guide does not define Mplify product specifications but can be used in combination with any product specifications defined by or compliant with Mplify.

4.5. High-Level Flow

Product Inventory 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 the Product Inventory's position within it.

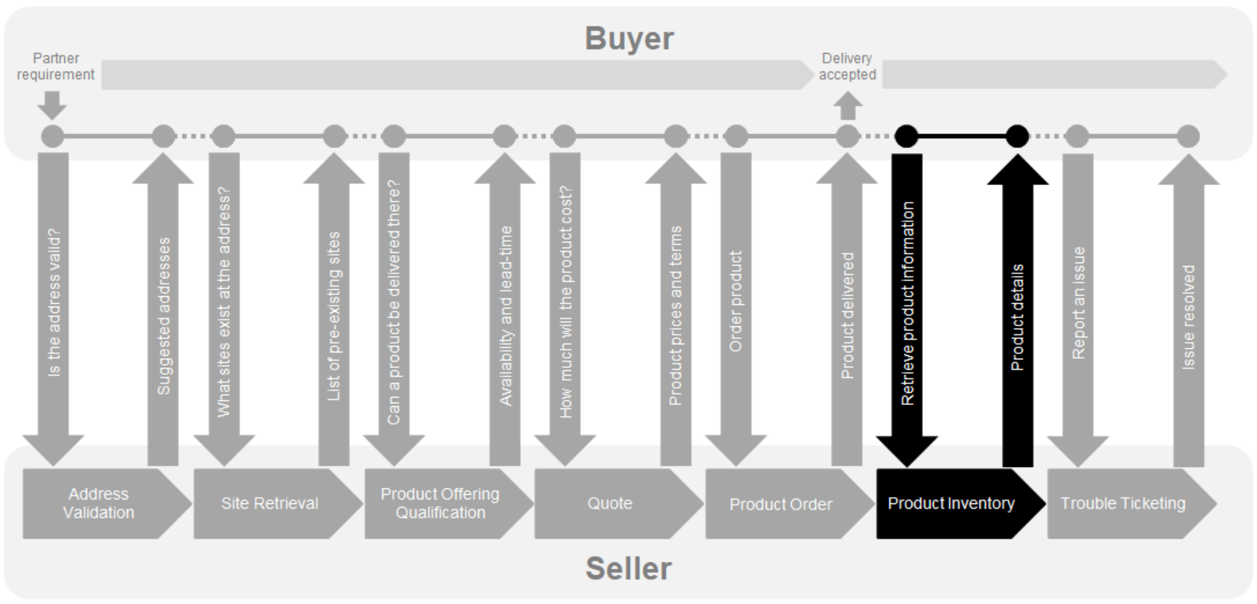


Figure 3. Cantata and Sonata End-to-End Function Flow

- 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 Service Site information including exact formats for Service 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.

5. API Description

This section presents the API structure and design patterns. It starts with the high-level use cases diagram. Then it describes the REST endpoints with use case mapping. Next, it gives an overview of the API resource model and an explanation of the design pattern that is used to combine product-agnostic and product-specific parts of API payloads. Finally, payload validation and API security aspects are discussed.

5.1. High-level use cases

Figure 4 presents a high-level use case diagram as specified in [MEF 81] in section 7.1. This picture aims to help understand the endpoint mapping. Use cases are described extensively in chapter 6

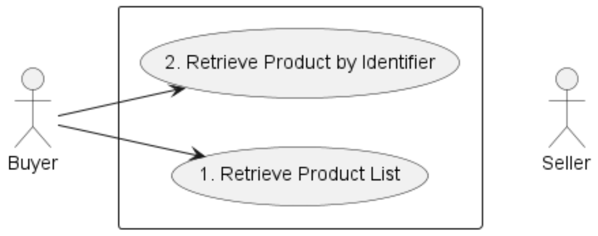


Figure 4. Use cases

5.2. Resource/endpoint Description

5.2.1. Seller Side Endpoints

Base URL for Cantata: `https://{{server}}:{{port}}{{?/seller_prefix}}/mefApi/cantata/productInventory/v2/`

Base URL for Sonata: `https://{{server}}:{{port}}{{?/seller_prefix}}/mefApi/sonata/productInventory/v8/`

The following API endpoints are implemented by the Seller and allow the Buyer to retrieve existing Product details or a list of Products. The endpoints and corresponding data model are defined in `productApi/inventory/productInventoryManagement.api.yaml`.

API endpoint	Description	MEF 81 Use case Mapping
`GET /product`	A request initiated by the Buyer to retrieve a list of Products (in any state) from the Seller based on a set of filter criteria.	UC 1: Retrieve Product List
`GET /product/{{id}}`	A request initiated by the Buyer to retrieve full details of a single Product based on a Product identifier.	UC 2: Retrieve Product by Identifier

Table 3. Seller Side Endpoints

[R1] The Buyer implementation **MUST** be able to use all REST methods listed in Table 3. [MEF81 R3], [MEF81 R4], [MEF81 R5], [MEF81 R6].

5.3. 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.

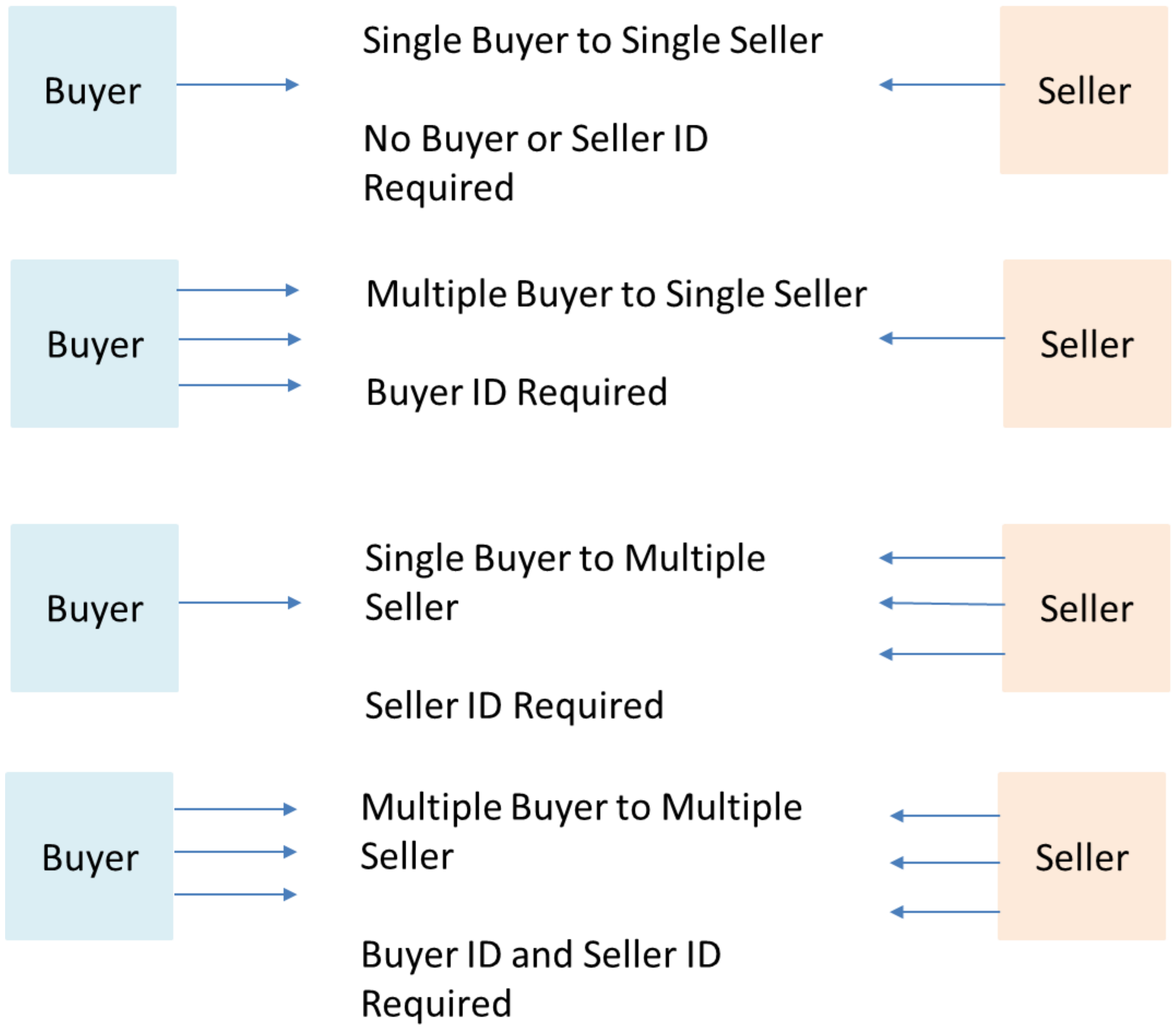

Buyer
Single Buyer to Single Seller
No Buyer or Seller ID Required
Seller
Buyer
Multiple Buyer to Single Seller
Buyer ID Required
Seller
Buyer
Single Buyer to Multiple Seller
Seller ID Required
Seller
Buyer
Multiple Buyer to Multiple Seller
Buyer ID and Seller ID Required
Seller

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.

[R2] 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]

[R3] 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]

5.4. Integration of Product Specific Attributes

Product specifications are defined using JsonSchema format and are integrated into an Inventory payload using a standard TMF extension pattern.

The extension hosting type in the API data model is `MEFProductConfiguration`. The `@type` attribute of that type must be set to a value that uniquely identifies the product specification. A unique identifier for Mplify standard product specifications is in URN format and is assigned by Mplify. This identifier is provided as root schema `$id` and in product specification documentation. Use of non-Mplify standard product definitions is allowed. In such a case, the schema identifier must be agreed between the Buyer and the Seller.

The example below shows a header of a Product Specification schema, where `"$id": urn:mef:lso:spec:sonata:access-eline-ovc:v5.0.0:all` is the above-mentioned URN:

```
'$schema': http://json-schema.org/draft-07/schema#
'$id': urn:mef:lso:spec:sonata:access-eline-ovc:v5.0.0:all
title: MEF LSO Sonata - Access Eline OVC Product Schema
```

Product specifications are provided as Json schemas without the `MEFProductConfiguration` context.

Product-specific attributes must be introduced into the `productConfiguration` attribute of the `MEFProduct`.

Implementations might choose to integrate selected product specifications into the data model during development. In such cases an integrated data model is built and product specifications are in an inheritance relationship with `MEFProductConfiguration` as described in OAS specification. This pattern is called **Static Binding**. The SDK is additionally shipped with a set of API definitions that statically bind all product-related APIs (POQ, Quote, Order, Inventory) with all corresponding product specifications available in the release. The snippets below present an example of a static binding of the Quote API with a number of Mplify product specifications, from both `MEFProductConfiguration` and product specification point of view:

```
MEFProductConfiguration:
  description:
    MEFProductConfiguration is used as an extension point for MEF-specific
    product/service payload. The `@type` attribute is used as a discriminator
  discriminator:
    mapping:
                                                urn:mef:lso:spec:sonata:carrier-ethernet-operator-uni:v5.0.0:all:
'#/components/schemas/CarrierEthernetOperatorUni'
      urn:mef:lso:spec:sonata:access-eline-ovc:v5.0.0:all: '#/components/schemas/AccessElineOvc'
    propertyName: '@type'
  properties:
    '@type':
      description:
        The name of the type, defined in the JSON schema specified above, for
        the product that is the subject of the Request. The named type must be a
        subclass of MEFProductConfiguration.
      type: string
```

```
AccessElineOvc:
  allOf:
    - $ref: '#/components/schemas/MEFProductConfiguration'
    - $ref: '#/components/schemas/AccessElineOvcCommon'
    - properties:
        uniEp:
          $ref: '#/components/schemas/AccessElineOvcEndPoint'
          description:
            MEF 26.2 sec. 16 - The OVC EP object for the OVC EP at the UNI. The
            UNI OVC End Point must be included in the Access E-Line Product.
        enniEp:
          $ref: '#/components/schemas/AccessElineOvcEndPoint'
          description:
            MEF 26.2 sec. 16 - The OVC EP object for the OVC EP at the ENNI. The
            ENNI OVC End Point must be included in the Access E-Line Product.
```

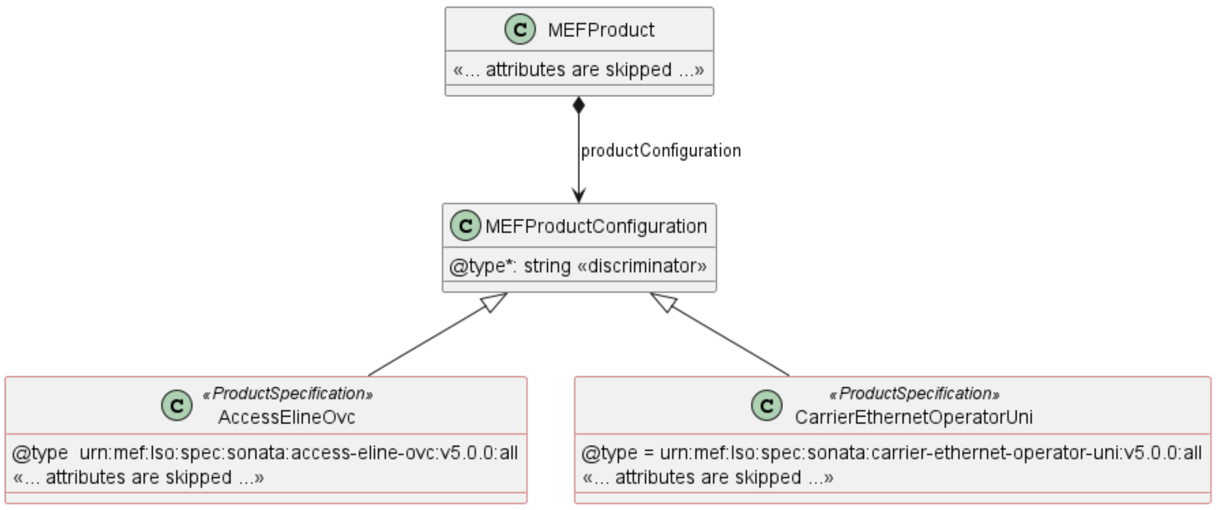
Alternatively, implementations might choose not to build an integrated model and choose different mechanisms allowing runtime validation of product-specific fragments of the payload. The system is able to validate a given product against a new schema without redeployment. This pattern is called **Dynamic Binding.**

Regardless of the chosen implementation pattern, the HTTP payload is exactly the same. Both implementation approaches must conform to the requirements specified below.

[R4] `MEFProductConfiguration` type is an extension point that **MUST** be used to integrate product specifications' properties into a request/response payload.

[R5] The `@type` property of `MEFProductConfiguration` **MUST** be used to specify the type of the extending entity.

[R6] Product attributes specified in the payload must conform to the product specification indicated by the `@type` property.



MEFProduct
«... attributes are skipped ...»
productConfiguration
MEFProductConfiguration
@type*: string «discriminator»
«ProductSpecification»
AccessElineOvc
@type urn:mef:lso:spec:sonata:access-eline-ovc:v5.0.0:all
«... attributes are skipped ...»
«ProductSpecification»
CarrierEthernetOperatorUni
@type = urn:mef:lso:spec:sonata:carrier-ethernet-operator-uni:v5.0.0:all
«... attributes are skipped ...»

Figure 6. The Extension Pattern

Figure 6 depicts two Mplify `<<ProductSpecifications>>` that represent Access E-Line and Operator UNI products. When these products are used in the payload the `@type` of `MEFProductConfiguration` takes `"urn:mef:lso:spec:sonata:access-eline-ovc:v5.0.0:all"` or `"urn:mef:lso:spec:sonata:carrier-ethernet-operator-uni:v5.0.0:all"` value to indicate which product specification should be used to interpret a set of product-specific attributes included in the payload.

The *all* suffix after the product type name in the URN comes from the approach that the product schemas may differ depending on the API they are used with. `all` means that this schema is applicable to all contexts.

This document uses samples of Access E-Line Product specification definitions to construct API payload examples in Section 6.

Note: The Access E-Line product is valid only in the Sonata context. It is used only for the explanation of the rules of combining the product-agnostic (envelope) and product-specific (payload) parts of the APIs. The examples do not represent full and consistent product configurations, they are not normative and are not kept up to date with their respective standards. It is out of the scope of this document to explain the details of any product.

5.5. Sample Product Specification

The Sonata SDK contains product specification definitions, from which Access E-Line [MEF 106] is used in the payload samples in this section. They are located in the SDK at:

```
\productSchema\carrierEthernet\operatorEthernet\accessEline\accessElineOvc.yaml
\productSchema\carrierEthernet\operatorEthernet\carrierEthernetOperatorUni\carrierE
thernetOperatorUni.yaml
```

Figure 7 depicts a simplified view of the defined relationships with other products and places.

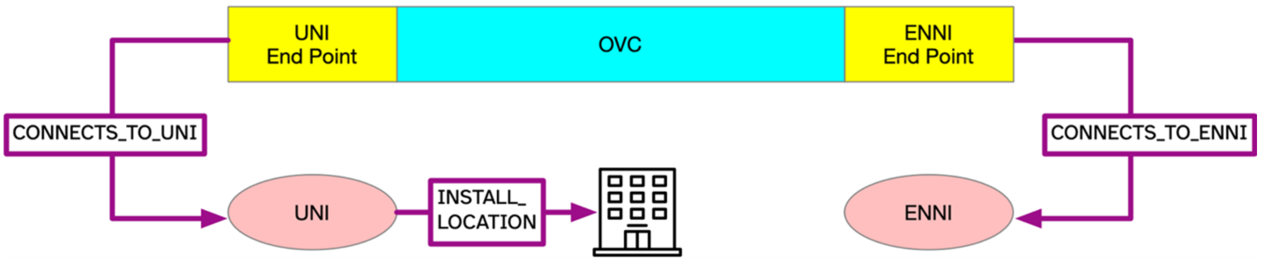


Figure 7. A Simplified View of Product and Place Relationships

Product specifications define a number of product-related and envelope-related requirements. Sample envelope-related requirements for Access E-Line:

- for an Access E-Line OVS product two mandatory relationship roles must be specified, one with the operator ENNI (`CONNECTS_TO_ENNI`) and a second with the operator UNI (`CONNECTS_TO_UNI`).
- in the case of a `modify` action, product relationships must have the same value as in the `add` action. They must not be changed
- for an operator UNI product a place relationship (`INSTALL_LOCATION`) must be specified
- in the case of a `modify` action, place relationships must have the same value as in the `add` action. They must not be changed

The product relationship (`product.productRelationship`) and the place relationship (`product.place`) are presented in Figure 7.

In case some of both product-related or envelope-related requirements are violated the Seller returns an error response to the Buyer which indicates specific functional errors. These errors are listed in the response body (a list of `Error422` entries) for HTTP `422` response.

5.6. Model Structural Validation

Model Structural Validation

The structure of the HTTP payloads exchanged via Quote API endpoints is defined using:

- OpenAPI version 3.0 for product-agnostic part of the payload
- JsonSchema (draft 7) for product-specific part of the payload

[R7] Implementations **MUST** use payloads that conform to these definitions.

[R8] The Buyer and the Seller **MUST NOT** use any operation, entity or attribute that is not explicitly defined or allowed by this standard.

[R9] A product specification may define additional consistency rules and requirements that **MUST** be respected by implementations.

These are defined for:

- required relation type, multiplicity to other items in the same quote request
- required relation type, multiplicity to entities in the Seller's product inventory
- related contact information roles that are to be defined at the item level
- relations to places (locations) and their roles that are to be defined at the item level

5.7. Providing the place information

When required by product specification, the Product must point to the place where the Product is provided. This is done with the use of the `place` attribute of type `RelatedPlaceRefOrQuery`, which is presented in Figure 8.

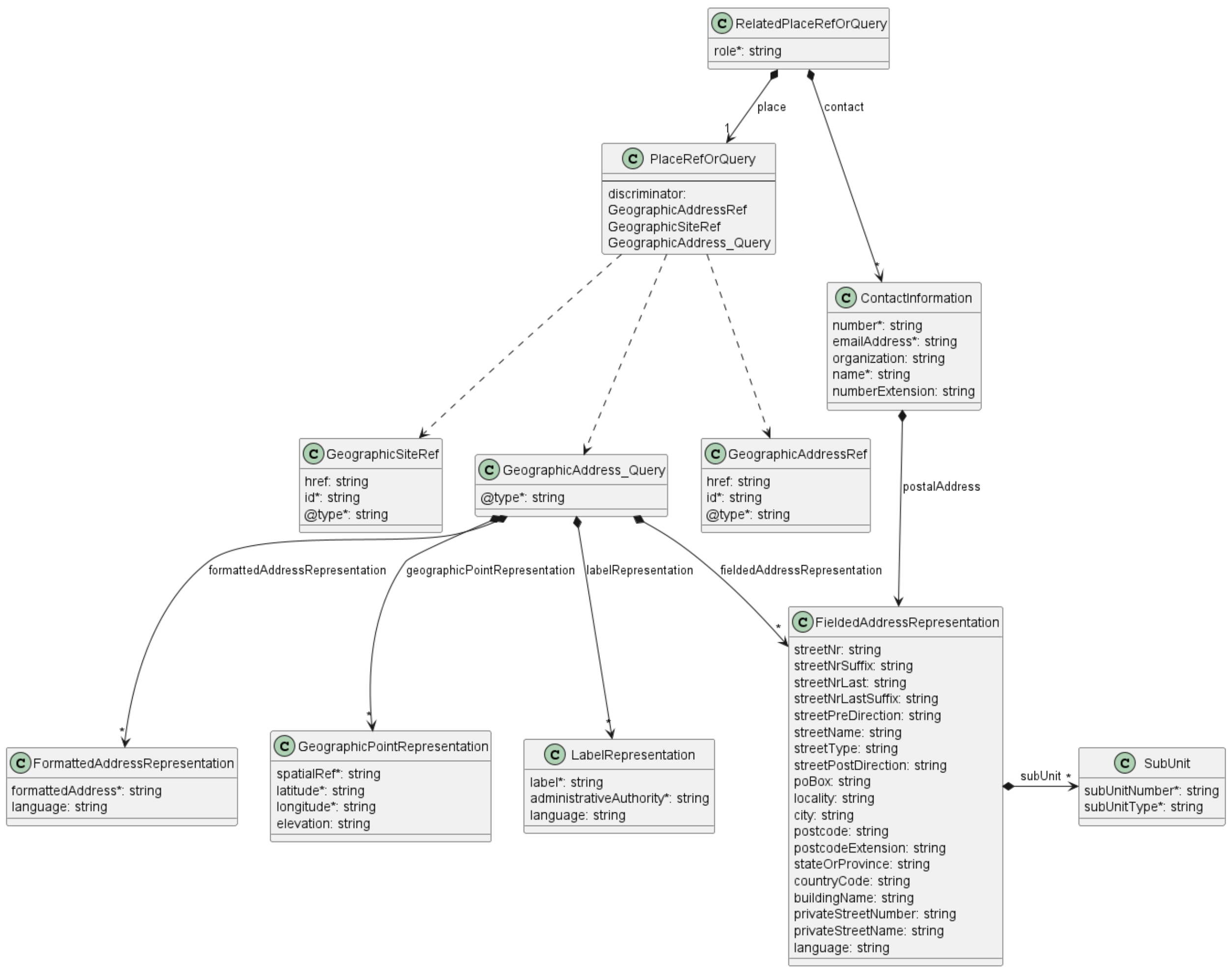


Figure 8. Data model - referring to a place

The `role` defines the function that the place plays for a given Product. The name of the role to be provided is strictly defined by the product specification. Usually, it is `INSTALL_LOCATION`.

`contact` provides additional information about the person to contact to get access to this place in case such access is required to complete the evaluation of this Quote Item.

`place` is where the actual place is pointed. The attribute is of type `PlaceRefOrQuery` which is an abstract class that can be of one of three types: `GeographicAddressRef`, `GeographicSiteRef`, or `GeographicAddress_Query`. The first two are simple identifiers to reference a `GeographicAddress` or `GeographicSite` respectively. The Buyer usually first validates the `GeographicAddress` and gets its identifier from the Seller and then optionally retrieves `GeographicSite` information for that address. In the unlikely case that the Seller does not provide the Address Validation API and the Buyer is not able to obtain the address identifier in any other way, the `GeographicAddressQuery` type might be used. It contains lists of Geographic Address Representations to provide the address information by value. There are four types of Geographic Address Representations:

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

One or more of these representations may be used to describe a single place.

The `GeographicAddress` model together with its above-mentioned representations and respective requirements are defined by Mplify 121.1 (chapter 5.3). That standard is the owner of those definitions. This API specification contains a model of `GeographicAddress` but does not define it. Any further changes of these types will update the API specification, but will not be reflected in this document.

The mandatory `@type` attribute of `GeographicSiteRef`, `GeographicAddressRef` and `GeographicAddress_Query` is used as a discriminator to unambiguously identify the intended type when using in the context of the `oneOf` section of `PlaceRefOrQuery` type.

5.8. 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 Interactions and Flows

This section provides a detailed insight into the API functionality, use cases, and flows. It starts with Table 4 presenting a list and short description of all business use cases then presents the variants of end-to-end interaction flows, and in the following subchapters describes the API usage flow and examples for each of the use cases.

Use Case #	Use Case Name	Use Case Description
1	Retrieve Product List	The Buyer requests a list of Products from the Seller based on filter criteria.
2	Retrieve Product by Identifier	The Buyer retrieves the details associated with the Product that matches the specified Identifier.

Table 4. Use cases description

6.1. Use case 1: Retrieve Product List

The Buyer can retrieve a list of `Products` by using a `GET /product` operation with desired filtering criteria. The attributes that are available to be used are:

- `status`
- `productSpecificationId`
- `productOfferingId`
- `externalId`
- `geographicalSiteId`
- `relatedProductId`
- `billingAccountId`
- `productOrderId`
- `startDate.gt`
- `startDate.lt`
- `lastUpdateDate.gt`
- `lastUpdateDate.lt`

The flow is a simple request - response pattern, as presented in Figure 9:

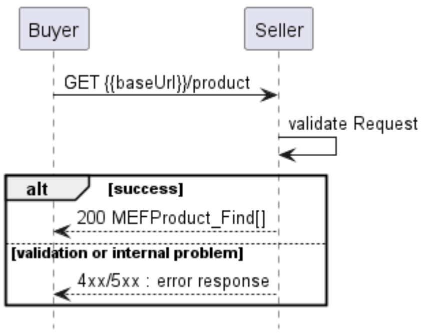


Figure 9. Use case 1: Retrieve Product List flow

The part of the model taking part in this use case is presented in Figure 10

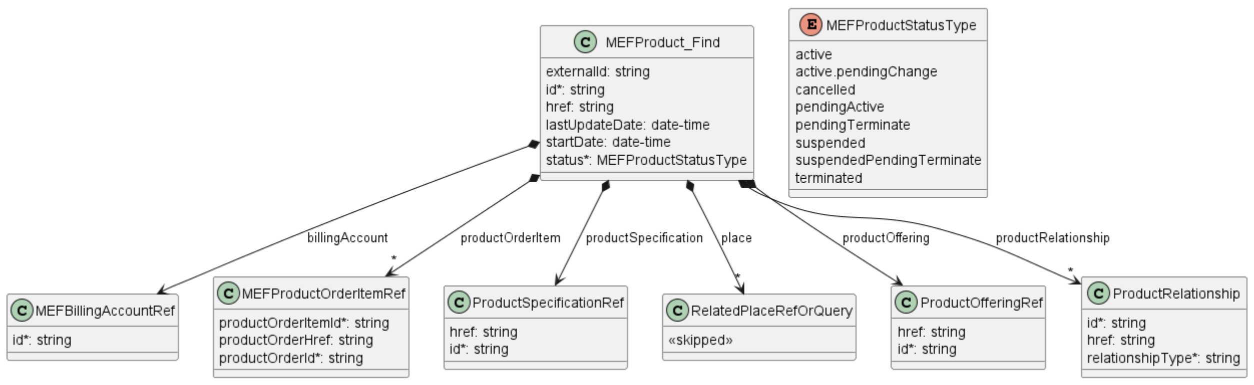


Figure 10. Use case 1: Retrieve Product List model

```
https://serverRoot/mefApi/sonata/productInventory/v8/product?status=pendingTerminate
```

The example above shows a Buyer's request to get all `Products` that are in the `pendingTerminate` status. The correct response (HTTP code `200`) in the response body contains a list of `MEFProduct_Find` objects matching the criteria. To get more details (e.g. the item level information), the Buyer has to query a specific `Product` by `id`.

The snippet below shows an example of a response with 1 product matched:

```
[
  {
    "id": "01494079-6c79-4a25-83f7-48284196d44d",
    "href": "{{baseUrl}}/product/01494079-6c79-4a25-83f7-48284196d44d",
    "status": "pendingTerminate",
    "externalId": "BuyerProduct-001",
    "lastUpdateDate": "2021-06-01T08:55:54.155Z",
    "startDate": "2021-05-01T08:55:54.155Z",
    "billingAccount": {
      "id": "00000000-1111-0000-0000-000000000001"
    },
    "productOffering": {
      "id": "00000000-5555-0000-0000-000000000001"
    },
    "productOrderItem": [
      {
        "productOrderItemId": "item-001",
        "productOrderHref": "{{baseUrl}}/productOrder/00000000-1111-2222-3333-000000000123",
        "productOrderId": "00000000-1111-2222-3333-000000000123"
      }
    ],
    "productRelationship": [
      {
        "relationshipType": "CONNECTS_TO_ENNI",
        "id": "SP1_ENNI"
      }
    ]
  }
]
```

[R10] The Buyer **MUST** be able to perform the Inventory Query without any filter criteria. [MEF81 R7]

[O1] The Seller **MAY** place a limit on the length of the list returned. [MEF81 O2]

[R11] In case of too many matching items are found (the definition of 'too many' is up to Seller's discretion), the Seller **MUST** return an `Error422` with `code=tooManyRecords`. [MEF81 O3]

The Buyer may also ask for pagination of the response when the number of results is too big. The following query attributes related to pagination can be provided:

- `limit` - number of expected list items
- `offset` - offset of the first element in the result list.

```
https://serverRoot/mefApi/sonata/productInventory/v8/product?status=active&limit=20&offset=0
```

The example above shows a Buyer's request to get the first twenty `MEFProducts` that are in `active` status. The correct response (HTTP code `200`) contains a list of `MEFProduct_Find` objects matching the criteria in the response body. To get more details (e.g. the item level information), the Buyer has to query a specific `MEFProduct` by id.

The Seller returns a list of elements that comply with the requested `limit`. If the requested `limit` is higher than the supported list size then the smaller list of results is returned. In that case, the size of the result is returned in the header attribute `X-Result-Count`. The Seller can indicate that there are additional results available using:

- `X-Total-Count` header attribute with the total number of available results
- `X-Pagination-Throttled` header set to `true`

[D1] The Seller **SHOULD** support the pagination mechanism.

[CR1]<[D1] Seller **MUST** use either `X-Total-Count` or `X-Pagination-Throttled` to indicate that the page was truncated and additional results are available.

[R12] In case no items matching the criteria are found, the Seller **MUST** return a valid response with an empty list.

[R13] The Seller **MUST** put the following attributes (if set) into the `MEFProduct_Find` object in the response: [MEF81 R8]:

- `id`
- `status`
- `externalId`
- `lastUpdateDate`
- `startDate`
- `billingAccount`
- `productOffering`
- `productOrderItem`
- `productRelationship`
- `productSpecification`
- `place`

6.2. Use case 2: Retrieve Product by Identifier

To get detailed up to up-to-date information about the Product, the Buyer sends a Retrieve Product by Identifier request using a `GET /product/{id}` operation.

The flow is a simple request - response pattern, as presented in Figure 11:

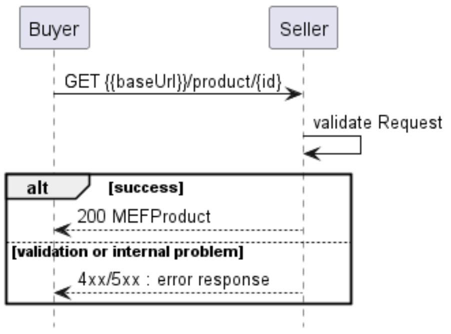


Figure 11. Use case 2: Retrieve Product by Identifier flow

The part of the model taking part in this use case is presented in Figure 12

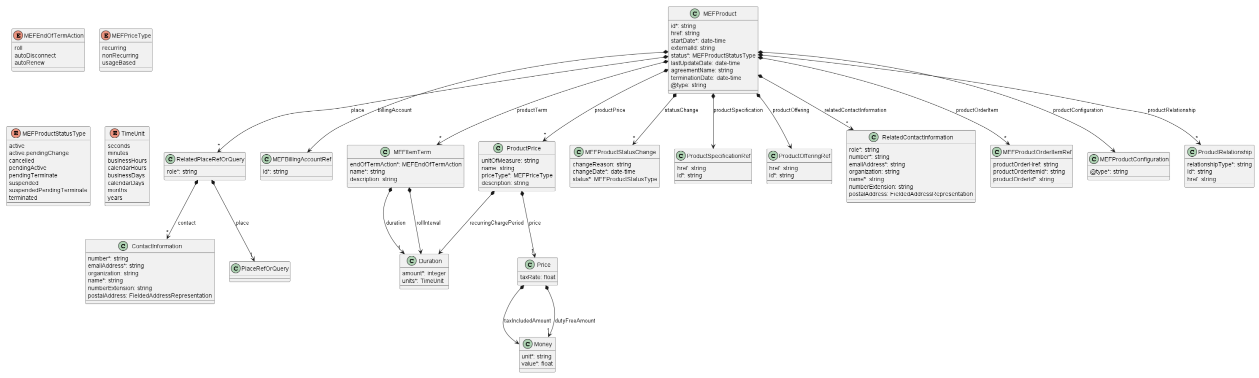


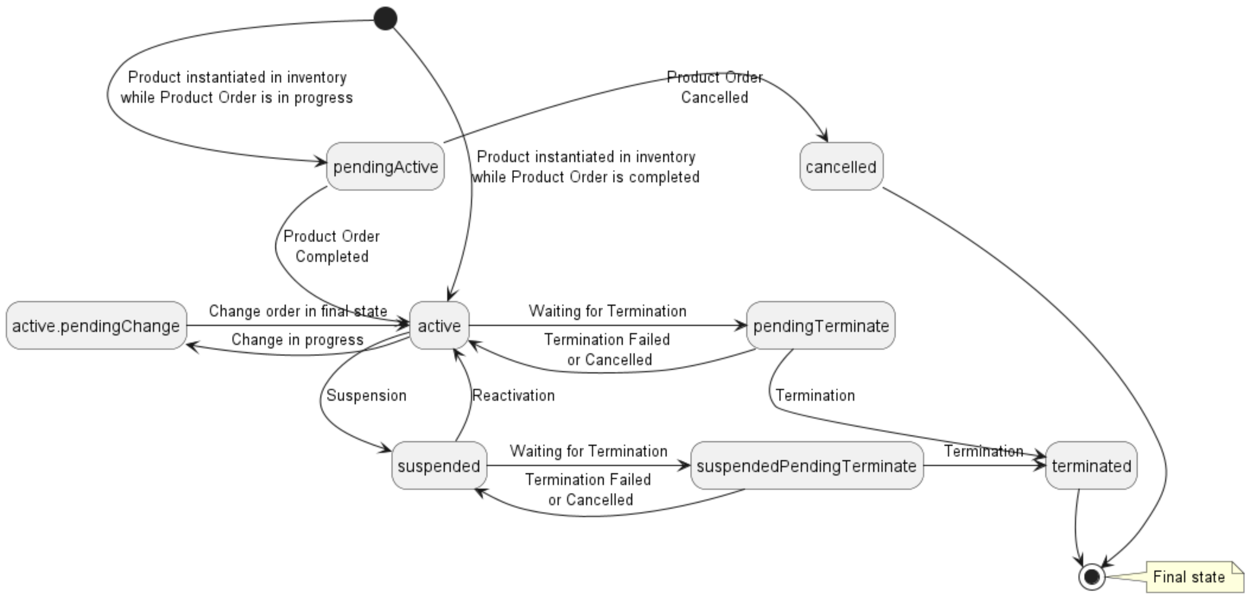
Figure 12. Use case 2: Retrieve Product model

Example request and response:

```
GET /mefApi/sonata/productInventory/v8/product/01494079-6c79-4a25-83f7-48284196d44d
```

```
{
  "id": "01494079-6c79-4a25-83f7-48284196d44d",
  "href": "{{baseUrl}}/product/01494079-6c79-4a25-83f7-48284196d44d",
  "externalId": "BuyerProduct-001",
  "lastUpdateDate": "2021-06-01T08:55:54.155Z",
  "startDate": "2021-05-01T08:55:54.155Z",
  "status": "pendingTerminate",
  "productConfiguration": {
    "@type": "urn:mef:lso:spec:sonata:access-eline-ovc:v5.0.0:all",
    "ceVlanIdPreservation": "PRESERVE",
    "maximumFrameSize": 1526,
    "listOfClassOfServiceNames": ["low"],
    "enniEp": {
      "identifier": "SP1_ENNI-EP1",
      "ingressClassOfServiceMap": {
        "mapType": "ENDPOINT",
        "map_M": "low",
        "l2cp_P": {
          "l2cpIdentifier": {
            "l2cpProtocolType": "LLC",
            "llcAddressOrEtherType": 66
          },
          "l2cpCosName": "low"
        }
      }
    },
    "uniEp": {
      "identifier": "NewYork_UNI-EP1",
      "ingressBandwidthProfilePerClassOfServiceName": [
        {
          "classOfServiceName": "low",
          "bwpFlow": {
            "cir": {
              "irValue": 0,
              "irUnits": "MBPS"
            },
            "cirMax": {
              "irValue": 0,
              "irUnits": "MBPS"
            },
            "eir": {
              "irValue": 10,
              "irUnits": "GBPS"
            },
            "eirMax": {
              "irValue": 10,
              "irUnits": "GBPS"
            }
          }
        }
      ],
      "ingressClassOfServiceMap": {
        "mapType": "ENDPOINT",
        "map_M": "low",
        "l2cp_P": {
          "l2cpIdentifier": {
            "l2cpProtocolType": "LLC",
            "llcAddressOrEtherType": 66
          },
          "l2cpCosName": "low"
        }
      }
    }
  },
  "billingAccount": {
    "id": "00000000-1111-0000-0000-000000000001"
  },
  "productOffering": {
    "id": "00000000-5555-0000-0000-000000000001"
  },
  "productOrderItem": [
    {
      "productOrderItemId": "item-001",
      "productOrderHref": "{{baseUrl}}/productOrder/00000000-1111-2222-3333-000000000123",
      "productOrderId": "00000000-1111-2222-3333-000000000123"
    }
  ],
  "price": {
    "taxRate": 8,
    "dutyFreeAmount": {
      "unit": "USD",
      "value": 50
    },
    "taxIncludedAmount": {
      "unit": "USD",
      "value": 54
    }
  },
  "productRelationship": [
    {
      "relationshipType": "CONNECTS_TO_ENNI",
      "id": "SP1_ENNI"
    }
  ],
  "productTerm": [
    {
      "duration": {
        "amount": 12,
        "units": "calendarMonths"
      },
      "endOfTermAction": "autoRenew",
      "name": "Yearly Subscription"
    }
  ],
  "relatedContactInformation": [
    {
      "emailAddress": "Seller.AssuranceTechnicalContact@seller.mef.com",
      "name": "Seller Assurance Technical Contact",
      "number": "+98-765-432-10",
      "role": "sellerAssuranceTechnicalContact "
    },
    {
      "emailAddress": "Seller.CommercialContact@seller.mef.com",
        "name": "Seller Commercial Contact",
        "number": "+98-765-432-11",
        "role": "sellerCommercialContact"
      },
      {
        "emailAddress": "Seller.SLAManagementContact@seller.mef.com",
        "name": "Seller SLA Management Contact",
        "number": "+98-765-432-12",
        "role": "sellerSlaManagementContact"
      },
      {
        "emailAddress": "Buyer.AssuranceTechnicalContact@buyer.mef.com",
        "name": "Buyer Assurance Technical Contact",
        "number": "+12-345-678-90",
        "role": "buyerAssuranceTechnicalContact "
      },
      {
        "emailAddress": "Buyer.CommercialContact@buyer.mef.com",
        "name": "Buyer Commercial Contact",
        "number": "+12-345-678-91",
        "role": "buyerCommercialContact"
      },
      {
        "emailAddress": "Buyer.SLAManagementContact@buyer.mef.com",
        "name": "Buyer SLA Management Contact",
        "number": "+12-345-678-92",
        "role": "buyerSlaManagementContact"
      }
    ],
    "statusChange": [
      {
        "changeDate": "2021-05-01T10:01:14.571Z",
        "status": "pendingActive"
      },
      {
        "changeDate": "2021-05-02T10:01:14.571Z",
        "status": "active"
      },
      {
        "changeDate": "2021-06-01T10:01:14.571Z",
        "status": "pendingTerminate"
      }
    ]
  }
```

Figure 13 below presents the Product's lifecycle.



Product instantiated in inventory while Product Order is in progress
Product Order Cancelled
pendingActive
Product instantiated in inventory while Product Order is completed
cancelled
Product Order Completed
active.pendingChange
Change order in final state
Change in progress
active
Waiting for Termination
Termination Failed or Cancelled
pendingTerminate
Suspension
Reactivation
Termination
suspended
Waiting for Termination
Termination Failed or Cancelled
suspendedPendingTerminate
Termination
terminated
Final state

Figure 13. Product State Machine

A detailed description of each state can be found in Table 5.

name	MEF 81 name	Description
active	ACTIVE	The Product Order has been successfully completed and the Product Order and associated Product Order Items are in the Inventory.
active. pendingChange	ACTIVE_ PENDING_CHANGE	The Product is active and has a Product Order to change the Product that is in progress. The status returns to active when the order is completed or if the Product Order is cancelled.
pendingTerminate	ACTIVE_ PENDING_TERMINATE	The Product is active and has a disconnect Order submitted by the Buyer that is in progress. The status changes to terminated if the disconnect is successful. The status returns to active if the Product Order fails to be completed or the Product Order is cancelled.
cancelled	CANCELLED	The Product is cancelled when the Product Order has moved to the cancelled.
pendingActive	PENDING	The Product Order has moved to the acknowledged state as defined in MEF 57.1 [11] and the Product ID for one or more Product Items has been passed from the Seller to the Buyer. The Product Order is not completed.
suspended	SUSPENDED	A Product has been successfully suspended. Products are placed into suspended state for some reason (e.g. nonpayment of the bill) and removed from suspended state for some reason (e.g. after payment).
suspended PendingTerminate	SUSPENDED_ PENDING_TERMINATE	The Product is in the process of being terminated by the Seller for some reason (e.g. non-payment). The status changes to terminated if the termination is successful. The status returns to suspended if the termination is not successful or cancelled.
terminated	TERMINATED	The Product has been successfully terminated via a disconnect Product order initiated by the Buyer or by the Seller for some reason (e.g. non-payment).

Table 5: Product statuses

Products that are terminated might be removed from the Seller's inventory system or shown in the terminated state at the Seller's discretion.

[R14] The stateChange **MUST** include a full object's state history including the initial state (also in the Immediate Response).

[R15] The Seller **MUST** provide the following contact information: [MEF81 R11]

Contact Role	`role` value	Description
Assurance Technical Contact	`buyerAssuranceTechnicalContact`, `sellerAssuranceTechnicalContact`	Operational contact such as Network Operations Center (NOC) for each party.
Commercial Contact	`buyerCommercialContact`, `sellerCommercialContact`	Contact for commercial issues like billing, contract extensions, etc. for each party.
SLA Management Contact	`buyerSlaManagementContact`, `sellerSlaManagementContact`	Contact for SLA-related issues, lifecycle reports, etc. for each party.

Table 6. Required Related Contact Information `role`

Note: The method used to update these contacts in the Seller's Inventory system is assumed to be agreed to between the Buyer and the Seller and is outside the scope of this document.

There is no step of Buyer's approval before moving a Product to `active` status. This might be part of a bilateral agreement or procedure that takes place outside of Product Inventory API.

Additions and changes to Products in the Product Inventory can be performed on with the use of Product Orders and the Product Order Management API, or by the request of the Seller.

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 Product Order API uses the error responses as 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 a case, the error message body structure might be aligned with the `Error`.

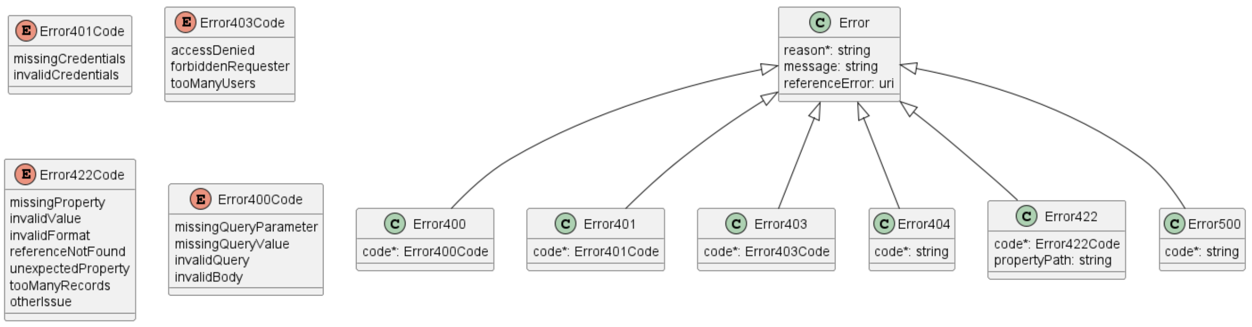


Figure 14. Data model types to represent an erroneous response

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 the 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. This code indicates that the server understood the request but refuses to authorize it. (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.

7.2. Management API Data model

Figure 15 presents the whole Product Inventory data model. The data types, requirements related to them and mapping to MEF 81 specification are discussed later in this section.

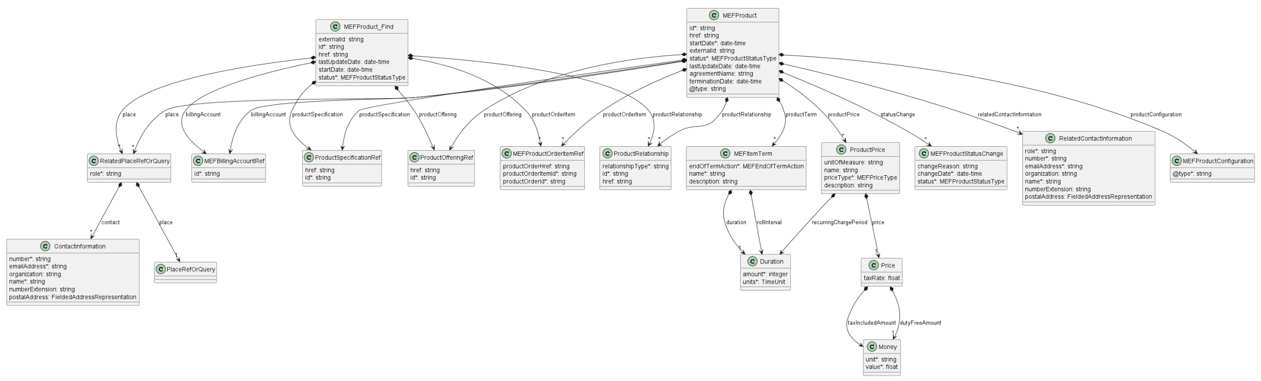


Figure 15. Product Inventory Data Model

7.2.1. Product

7.2.1.1. Type MEFProduct

Description: A product is realized as one or more service(s) and / or resource(s).

Name	Type	M/O	Description	MEF 81
id	string	M	Unique identifier of the product	Seller Product Identifier
href	string	O	Reference of the product	Not represented in MEF 81
startDate	date-time *format = date-time*	M	Is the date from which the product starts. Start date is when the product is active for the first time (when the install in the product order has been processed).	Initial Order Completion Date
externalId	string	O	Buyer identifier of the product	Buyer Product Identifier
status	MEFProduct-StatusType	M	The lifecycle status of the product.	Status
statusChange	MEFProduct-StatusChange[]	M	status change for the Product	Not represented in MEF 81
lastUpdateDate	date-time *format = date-time*	O	Latest date when the product has been updated.	Last Updated Date
agreementName	string	O	Name of the agreement. The name is unique between the Buyer and the Seller.	Agreement Name
productSpecification	ProductSpecificationRef	O	A reference to a Product Specification of the Product	Product Specification ID
place	RelatedPlace-RefOrQuery[]	O	A list of locations that are related to the Product. For example an installation location	Service Site Identifier (Geographical Site ID)
productOffering	ProductOfferingRef	O	A particular Product Offering defines the technical and commercial attributes and behaviors of a Product.	Product Offering ID

Name	Type	M/O	Description	MEF 81
related-ContactInformation	Related-ContactInformation[]	O	Party playing a role for this Product	Buyer Assurance Technical Contact, Buyer Commercial Contact, Buyer SLA Management Contact, Seller Assurance Technical Contact, Seller Commercial Contact, Seller SLA Management Contact
billingAccount	MEFBillingAccountRef	O	The Billing Account associated with the Product	Billing Account Identifier
productOrderItem	MEFProduct-OrderItemRef[]	O	The Product Order Item of the associated Product order that resulted in the creation of this Product.	Product Order Identifier, Product Order Item Identifier
productTerm	MEFItemTerm[]	O	Term of the Product	Product Order Item Term, Product Order Item Term End Date
terminationDate	date-time *format = date-time*	O	Is the date when the product was terminated. Termination date (commercial) is when the product has been terminated (when the disconnect in the product order has been processed).	Termination Date
productConfiguration	MEFProduct-Configuration	O	MEFProductConfiguration is used to specify the MEF specific product payload.	Product
productRelationship	ProductRelationship[]	O	A list of references to existing products that are related to the Product.	Product Relationship
productPrice	ProductPrice[]	O	A list of Prices associated with the Product	Product Price

7.2.1.2. Type MEFProduct_Find

Description: Class used to provide product overview retrieved in GET (by list) operation

Name	Type	M/O	Description	MEF 81
productSpecification	ProductSpecificationRef	O	A reference to a Product Specification of the Product	Product Specification ID
place	RelatedPlaceRefOrQuery[]	O	A list of locations that are related to the Product. For example an installation location	Service Site Identifier (Geographical Site ID)
productOffering	ProductOfferingRef	O	A particular Product Offering defines the technical and commercial attributes and behaviors of a Product.	Product Offering ID
lastUpdateDate	date-time *format = date-time*	O	Latest date when the product has been updated.	Last Updated Date
externalId	string	O	This identifier is optionally provided during the product ordering and stored for informative purpose in the seller inventory	Buyer Product Identifier
productRelationship	ProductRelationship[]	O	A list of references to existing products that are related to the Product.	Product Relationship
id	string	M	Unique identifier of the product	Seller Product Identifier
href	string	O	Reference of the product	Not represented in MEF 81

Name	Type	M/O	Description	MEF 81
billingAccount	MEFBillingAccountRef	O	The Billing Account associated with the Product	Billing Account Identifier
productOrderItem	MEFProductOrderItemRef[]	O	The Product Order Item of the associated Product order that resulted in the creation of this Product.	Product Order Identifier, Product Order Item Identifier
startDate	date-time *format = date-time*	O	The date from which the product starts	Initial Order Completion Date
status	MEFProductStatusType	M	The lifecycle status of the product.	Status

7.2.1.3. `enum` MEFProductStatusType

Description: Possible values for the status of a MEF product

name	MEF 81 name
`active`	ACTIVE
`active.pendingChange`	ACTIVE_PENDING_CHANGE
`pendingTerminate`	ACTIVE_PENDING_TERMINATE
`cancelled`	CANCELLED
`pendingActive`	PENDING
`suspended`	SUSPENDED
`suspendedPendingTerminate`	SUSPENDED_PENDING_TERMINATE
`terminated`	TERMINATED

7.2.1.4. Type MEFProductStatusChange

Description: Holds the reached status, reasons and associated date the Product Order status changed, populated by the Seller.

Name	Type	M/O	Description	MEF 81
changeReason	string	O	The reason why the status changed.	Not represented in MEF 81
changeDate	date-time *format = date-time*	M	The date and time the status changed.	Not represented in MEF 81
status	MEFProductStatusType	M	Status of the product	Not represented in MEF 81

7.2.1.5. Type ProductPrice

Description: An amount, usually of money, that represents the actual price paid by a Customer for a purchase, a rent or a lease of a Product. The price is valid for a defined period of time.

Name	Type	M/O	Description	MEF 81
unitOfMeasure	string	O	Unit of Measure if price depending on it (Gb, SMS volume, etc..)	Not represented in MEF 81
price	Price	M	Value of the Price	Price
name	string	O	A short descriptive name such as "Subscription price".	Price Name
priceType	MEFPriceType	M	A category that describes the price, such as recurring, nonRecurring, usageBased	Price Type
description	string	O	A narrative that explains in detail the semantics of this product price.	Price Description
recurringChargePeriod	Duration	O	Used for a recurring charge to indicate a period	Price Recurring Change Period

7.2.2. Common

Types described in this subsection are shared among two or more Cantata and Sonata APIs.

7.2.2.1. Type Duration

Description: A Duration in a given unit of time e.g. 3 hours, or 5 days.

Name	Type	M/O	Description	MEF 81
amount	integer *minimum = 0*	M	Duration (number of seconds, minutes, hours, etc.)	Product Order Item Term
units	TimeUnit	M	Time unit enumerated	Product Order Item Term

7.2.2.2. Type MEFBillingAccountRef

Description: A reference to the Buyer's Billing Account

Name	Type	M/O	Description	MEF 81
id	string	M	Identifies the buyer's billing account to which the recurring and non-recurring charges for this order or order item will be billed. Required if the Buyer has more than one Billing Account with the Seller and for all new Product Orders.	Billing Account

7.2.2.3. Type MEFItemTerm

Description: The term of the Item

Name	Type	M/O	Description	MEF 81
duration	Duration	M	Duration of the term	Not represented in MEF 81
endOfTermAction	MEFEndOfTermAction	M	The action that needs to be taken by the Seller once the term expires	Not represented in MEF 81
name	string	M	Name of the term	Not represented in MEF 81
description	string	O	Description of the term	Not represented in MEF 81
rollInterval	Duration	O	The recurring period that the Buyer is willing to pay to the end of upon disconnecting the Product after the original term has expired.	Not represented in MEF 81

7.2.2.4. `enum` MEFEndOfTermAction

Description: The action the Seller will take once the term expires.

Value	MEF 81
roll	ROLL
autoDisconnect	AUTO_DISCONNECT
autoRenew	AUTO_RENEW

7.2.2.5. `enum` MEFPriceType

Description: Indicates if the price is for recurring or non-recurring charges.

Value	MEF 81
recurring	RECURRING
nonRecurring	NON_RECURRING
usageBased	USAGE_BASED

7.2.2.6. Type MEFProductConfiguration

Description: MEFProductConfiguration is used as an extension point for MEF specific product/service payload. The `@type` attribute is used as a discriminator

Name	Type	M/O	Description	MEF 81
@type	string	M	The name of the type, defined in the JSON schema specified above, for the product that is the subject of the POQ Request. The named type must be a subclass of MEFProductConfiguration.	Not represented in MEF 81

7.2.2.7. Type MEFProductOrderItemRef

Description: A reference to a ProductOrder item

Name	Type	M/O	Description	MEF 81
productOrderHref	string	O	Reference of the related ProductOrder.	Not represented in MEF 81
productOrderItemId	string	M	Id of an Item within the Product Order	Product Order Item Identifier
productOrderId	string	M	Unique identifier of a ProductOrder.	Product Order Identifier

7.2.2.8. Type Price

Description: Provides all amounts (tax included, duty-free, tax rate) and used currency of a Price

Name	Type	M/O	Description	MEF 81
taxRate	float *format = float*	O	Price Tax Rate. Unit: [%]. E.g. value 16 stand for 16% tax.	Price Tax Rate
taxIncludedAmount	Money	O	All taxes included amount (expressed in the given currency)	Price Tax Included Amount
dutyFreeAmount	Money	M	All taxes excluded amount (expressed in the given currency)	Price Duty Free Amount

7.2.2.9. Type Money

Description: A base / value business entity used to represent money

Name	Type	M/O	Description	MEF 81
unit	string	M	Currency (ISO4217 norm uses 3 letters to define the currency)	Not represented in MEF 81
value	float *format = float*	M	A positive floating point number	Not represented in MEF 81

7.2.2.10. Type ProductOfferingRef

Description: A reference to a Product Offering offered by the Seller to the Buyer. A Product Offering contains the commercial and technical details of a Product sold by a particular Seller. A Product Offering defines all of the commercial terms and, through association with a particular Product Specification, defines all the technical attributes and behaviors of the Product. A Product Offering may constrain the allowable set of configurable technical attributes and/or behaviors specified in the associated Product Specification.

Name	Type	M/O	Description	MEF 81
href	string	O	Hyperlink to a Product Offering in Sellers catalog. In case Seller is not providing a catalog API this field is not used. The catalog is provided by the Seller to the Buyer during onboarding.	Not represented in MEF 81
id	string	M	id of a Product Offering. It is assigned by the Seller. The Buyer and the Seller exchange information about offerings' ids during the onboarding process.	Product Offering ID

7.2.2.11. Type ProductRelationship

Description: A relationship to existing Product. The requirements for usage for given Product are described in the Product Specification.

Name	Type	M/O	Description	MEF 81
relationshipType	string	M	Specifies the type (nature) of the relationship to the related Product. The nature of required relationships vary for Products of different types. For example, a UNI or ENNI Product may not have any relationships, but an Access E-Line may have two mandatory relationships (related to the UNI on one end and the ENNI on the other). More complex Products such as multipoint IP or Firewall Products may have more complex relationships. As a result, the allowed and mandatory `relationshipType` values are defined in the Product Specification.	Relationship Nature
id	string	M	unique identifier	Seller Product Identifier
href	string	O	Hyperlink of the referenced product	Not represented in MEF 81

7.2.2.12. Type ProductSpecificationRef

Description: A reference to a structured set of well-defined technical attributes and/or behaviors that are used to construct a Product Offering for sale to a market.

Name	Type	M/O	Description	MEF 81

Name	Type	M/O	Description	MEF 81
href	string	O	Hyperlink to a Product Specification in Sellers catalog. In case Seller is not providing a catalog API this field is not used. The catalog is provided by the Seller to the Buyer during onboarding.	Not represented in MEF 81
id	string	M	Unique identifier of the product specification	Product Specification ID

7.2.2.13. Type RelatedContactInformation

Description: Contact data for a person or organization that is involved in the product offering qualification. In a given context it is always specified by the Seller (e.g. Seller Contact Information) or by the Buyer.

Name	Type	M/O	Description	MEF 81
role	string	M	The role of the particular contact in the request	Contact Role
number	string	M	Phone number	Contact Phone Number
emailAddress	string	M	Email address	Contact email Address
postalAddress	FieldedAddress-Representation	O	Identifies the postal address of the person or office to be contacted.	Not represented in MEF 81
organization	string	O	The organization or company that the contact belongs to	Not represented in MEF 81
name	string	M	Name of the contact	Contact Name
numberExtension	string	O	Phone number extension	Contact Phone Number Extension

7.2.2.14. `enum` TimeUnit

Description: Represents a unit of time.

Value	MEF 81
seconds	SECONDS
minutes	MINUTES
businessHours	BUSINESS_HOURS
calendarHours	CALENDAR_HOURS
businessDays	BUSINESS_DAYS
calendarDays	CALENDAR_DAYS

Value	MEF 81
months	MONTHS
years	YEARS

7.2.3. Place representation

7.2.3.1. Type RelatedPlaceRefOrQuery

Description: Allows pointing to a place by referring to a GeographicAddress, GeographicSite, or providing GeographicAddress by value. It also provides additional information like the `role` the place plays for given Product and `contact` needed access to this place.

Name	Type	M/O	Description	MEF 81
place	PlaceRefOrQuery	M		Service Site Reference
role	string	M	Role of this place. The values that can be specified here are described by Product Specification (e.g. "INSTALL_LOCATION").	Not represented in MEF 81
contact	ContactInformation[]	O	The person to call to get access to this place in case such access is required to complete the evaluation of this POQ Item.	Not represented in MEF 81

7.2.3.2. Type PlaceRefOrQuery

Description: A place described by reference to a Geographic Address, Geographic Site or by Geographic Address Representations.

7.2.3.3. 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	MEF 81
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

Name	Type	M/O	Description	MEF 81
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

7.2.3.4. 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	MEF 81
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
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

Name	Type	M/O	Description	MEF 81
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
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

7.2.3.5. Type FormattedAddressRepresentation

Description: A freeform text representation agreed to by the Buyer and Seller.

Name	Type	M/O	Description	MEF 81
formattedAddress	string	M	A formatted Address Representation that contains a non-fielded address.	Formatted Address
language	string *minLength = 2* *maxLength = 2*	O	The language in which the address is expressed. Based on ISO 639:2023	Language

7.2.3.6. Type GeographicPointRepresentation

Description: A GeographicPointRepresentation defines a geographic point through coordinates.

Name	Type	M/O	Description	MEF 81
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

7.2.3.7. Type LabelRepresentation

Description: A unique identifier controlled by a generally accepted independent administrative authority that specifies a fixed geographical location.

Name	Type	M/O	Description	MEF 81
label	string	M	The unique reference to a Geographic Address assigned by the Administrative Authority.	Installation Place Label
administrativeAuthority	string	M	The organization or standard from the organization that administers this Geographic Address 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. Based on ISO 639:2023	Language

7.2.3.8. Type GeographicAddressRef

Description: A reference to a Geographic Address resource available through Address Validation API.

Name	Type	M/O	Description	MEF 81
href	string	O	Hyperlink to the referenced Address. Hyperlink MAY be used by the Seller in responses. Hyperlink MUST be ignored by the Seller in case it is provided by the Buyer in a request.	Not represented in MEF 80

Name	Type	M/O	Description	MEF 81
id	string	M	Identifier of the referenced Geographic Address. This identifier is assigned during a successful address validation request (Geographic Address Management API)	Installation Place Identifier
@type	string	M	Used to unambiguously designate the class type when using `oneOf`	Not represented in MEF 80

7.2.3.9. Type GeographicSiteRef

Description: A reference to a Geographic Site resource available through Service Site API

Name	Type	M/O	Description	MEF 81
href	string	O	Hyperlink to the referenced Site. Hyperlink MAY be used by the Seller in responses. Hyperlink MUST be ignored by the Seller in case it is provided by the Buyer in a request.	Not represented in MEF 80
id	string	M	Identifier of the referenced Geographic Site.	Site Identifier
@type	string	M	Used to unambiguously designate the class type when using `oneOf`	Not represented in MEF 80

7.2.3.10. Type SubUnit

Description: Allows for sub unit identification

Name	Type	M/O	Description	MEF 81
subUnitNumber	string	M	The discriminator used for the subunit, often just a simple number but may also be a range.	Not represented in MEF 81
subUnitType	string	M	The type of subunit e.g. BERTH, FLAT, PIER, SUITE, SHOP, TOWER, UNIT, WHARF.	Not represented in MEF 81

7.2.3.11. Type ContactInformation

Description: Contact data for a person or organization that is involved in the product offering qualification. In a given context it is always specified by the Seller (e.g. Seller Contact Information) or by the Buyer.

Name	Type	M/O	Description	MEF 81
number	string	M	Phone number	Contact Phone Number

Name	Type	M/O	Description	MEF 81
emailAddress	string	M	Email address	Contact Email Address
postalAddress	FieldedAddressRepresentation	O	Identifies the postal address of the person or office to be contacted.	Contact Postal Address
organization	string	O	The organization or company that the contact belongs to	Contact Organization
name	string	M	Name of the contact	Contact Name
numberExtension	string	O	Phone number extension	Contact Phone Number Extension

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