D3.6 Semantic Toolkit- Final Version

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List of Acronyms

Abbreviation / acronym	Description
API	Application Programming Interface
ATU	Administrative Territorial Unit
BB	Building Block
BBXL	Business Document Metadata Service Location
BRIS	Business Registers Interconnection System
CAAR	Cross-border Authority Authorisation Registry
CBC	Common Basic Components
CEF	Connecting Europe Facility
CPOV	Core Public Organization Vocabulary
CPSV	Core Public Services Vocabulary
DBA	Doing Business Abroad – one of the three DE4A pilots
DC	Data Consumer
DE	Data Evaluator
DE4A	Digital Europe for All
DO	Data Owner
DP	Data Provider
DR	Data Requestor
DSD	Data Services Directory
DT	Data Transferor
EC	European Commission
EDCI	Europass Digital Credentials Infrastructure
EDM	Exchange Data Model
EDU	Competent authority for education public services
eID	Electronic Identification
ESL	Evidence Service Locator
FOAF	Friend of a Friend
GUI	Graphical User Interface
IAL	Issuing Authority locator
IDK	Information Desk
IEM	Information Exchange Model IEM
IHU	International Hellenic University
IM	Intermediation
IOP	Interoperability
ISA2	Interoperability solutions for public administrations, businesses and citizens
ISCED-F	International Standard Classification of Education-Fields
ISO	International Organization for Standardization

Abbreviation / acronym	Description
JSON	JavaScript Object Notation
LAU	Local Administrative Unit
MA	Moving Abroad – one of the three DE4A pilots
MOR	Multilingual Ontology Repository
MVP	Minimum Viable Product
NUTS	Nomenclature of Territorial Units for Statistics
OASIS	Organization for the Advancement of Structured Information Standards
OOP	Once-Only Principle
OWL	Web Ontology Language
PKI	Public Key Infrastructure
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
REST	Representational State Transfer
SDG	Single Digital Gateway
SKOS	Simple Knowledge Organization System
SPARQL	SPARQL Protocol and RDF Query Language
TL	Task Leader
U	User
UC	Use Case
UML	Unified Modelling Language
UI	User Interface
USI	User Supported Intermediation
W3C	World Wide Web Consortium
WP	Work Package
WPL	Work Package Leader
XML	Extensible Markup Language
XSD	XML Schema

Glossary

Abbreviation / acronym	Description
Application Profile	An application profile (AP), as yet another group of assets within the 'models' category, describes how a standard is to be applied in a particular domain or application. Standards typically do not contain constraints such as cardinality; these constraints are defined in the application profile. An application profile only applies to the specified domain [29].
Code lists	Predefined set of terms from which some statistical coded concepts take their values [30].
Canonical Evidence Type	Evidence type defined by an agreement on the fact proved and the information provided with a structured data model that include a common set of attributes [31]. Used to provide a common classification of domestic evidence types and a semantic interoperability agreement for their information to remove linguistic and semantic barriers.
Canonical Evidence	Piece of evidence issued according to a certain canonical evidence type by an issuing authority, who guarantees that its information is consistent with the information provided by the corresponding lawful domestic evidence.
Canonical Event Catalogue	Catalogue of events that can change the contents of a base registry, according to a semantic agreement
Controlled Vocabulary	A consistent way to describe data. They are standardized and organized arrangements of words and phrases presented as alphabetical lists of terms or as thesauri and taxonomies with a hierarchical structure of broader and narrower terms [32].
Criteria	Procedural requirements as conditions to be met and used as a basis for making judgements or decisions in the procedure.
Data Model	A data model is a collection of entities, their properties and the relationships among them, which aims at formally representing a domain, a concept or a real-world thing. It includes core vocabularies [33].
Ontology	An ontology is a formal, explicit specification of a shared conceptualisation. In computer science and information science, an ontology encompasses a representation, formal naming and definition of the categories, properties and relations between the concepts, data and entities that substantiate one, many or all domains of discourse [34].
Procedure	A sequence of actions that must be taken by users to satisfy the requirements, or to obtain from a competent authority a decision, in order to be able to exercise their rights as referred to in point (a) of Article 2(2) [35].
Provision	Availability of a service offered by a specific issuing authority to provide a specific canonical evidence type (evidence provision) or the subscription to a specific Canonical Event Catalogue (subscription provision).
Scenario	One typical way in which a system is used or in which a user carries out some activity.
Semantic Asset	A specific type of standard which involves highly reusable metadata (e.g., XML Schema, generic data models) and/or reference data (e.g. code lists, taxonomies, dictionaries, vocabularies).

Abbreviation / acronym	Description
Semantic Component	A component (e.g. Information Desk, Information Exchange Model) of the semantic interoperability framework that uses semantic assets to perform certain functionalities.
Semantic Interoperability Framework	A framework that consists of semantic components and the related semantic assets to facilitate cross-border exchange of evidences.
Taxonomy	A systematic arrangement in groups or categories of concepts according to established criteria [36].
Use case	A specification of one type of interaction with a system. One use case may involve several scenarios (usually a main success scenario and alternative scenarios)
User	Anyone who is a citizen of the EU, a natural person residing in a Member State or a legal person having their registered office in a Member State, and who accesses the information, the procedures, or the assistance or problem-solving services, referred to in Article 2(2), through the gateway [35].
Vocabulary	A collection of terms for a particular purpose. Vocabularies can range from simple ones, such as the widely used RDF schema, FOAF and DCMI element sets, to complex vocabularies with thousands of terms, such as those used in healthcare to describe symptoms, diseases and treatments. Vocabularies play a very important role in linked data, specifically to help with data integration. For example, metadata vocabulary. The use of this term overlaps with that of 'ontology' [37].
XML Schema	An XML schema is a description of a type of XML document, typically expressed in terms of constraints on the structure and content of documents of that type, above and beyond the basic syntactical constraints imposed by XML itself [38].

Executive Summary

This present deliverable is the final version of the DE4A toolkit developed for the semantic layer stack in the context of DE4A WP3 "Semantic Interoperability Solutions" for delivering DE4A cross-border public services. The document provides an updated version of the DE4A toolkit that was presented in D3.5 "*Semantic Toolkit – Initial version*" [6].

The implementation process of the DE4A toolkit follows an agile methodology, by considering D3.2 *"Final requirements for semantic assets"* and D3.4 *"Semantic Framework-Final version"* that incrementally developed from requirements to building the data models, with tools resulting from the pilot requirements and the other emerging assets identified.

To that end, first, the document presents the tools and technologies that are used to model the DE4A pilots canonical evidences. These tools and the pilot-specific ontologies provide the basis for the implementation process of the DE4A common evidence data models (canonical evidence). Furthermore, the DE4A semantic components, introduced in the deliverable D3.4 *"Semantic framework- Final Version"*, for obtaining requisite information and exchanging messages are designed by using a standard approach for ontology modelling with competency questions. The semantic interoperability framework and the tools are lightweight i.e., they are tailored for the simplest scenarios defined by the DE4A pilots, as described subsequently.

The main results and findings of this deliverable are:
▸ Identification of the DE4A canonical evidence types and implementation of the respective data models in XML Schema format for the piloting of the use cases of the project.
▸ Final specification and semantic model of the DE4A Information Desk (IDK) for helping data evaluators to locate the issuing authorities and the evidences.
▸ Final specification of the DE4A Information Exchange Model (IEM) for the provision of public procedures through modelling the payload of request and response messages for the evidence exchange.

The outcomes of this deliverable serve as input to WP4 "Cross-border Pilots for Citizens and Business and Evaluation", for the running phase of the pilots, and to WP5 "Common Component Design & Development", for the implementation of the interfaces for authorities involved in the exchange process to make the composition of request and response messages.

1 Introduction

1.1 Purpose of the document

The purpose of this document is to describe the final version of the DE4A toolkit of the semantic layer stack for delivering cross-border public services related to the DE4A pilot use cases (Studying Abroad, Doing Business Abroad and Moving Abroad).

The description of semantic toolkit includes:

▸ The semantic tools for XML Schema (XSD) management used during the implementation of the canonical evidence data models.
▸ The implementation of pilot related canonical evidence data models in XSD format that will be part of the payload for evidence exchange.
▸ The specification of the Information Desk and conceptual model regarding API implementation that will facilitate Data Consumers (DC) and Data Providers (DP) to obtain the required information before making requests and/or sending responses to the respective stakeholders.
▸ The implementation of logical model for the Information Exchange Model to model the payload of request and response messages for the evidence exchange.

This deliverable considers the semantic components tailored to the needs of the small set of selected countries that pilot DE4A use cases. For this purpose, the canonical evidence types contain the minimum set of common attributes with basic data types (initially based on the ISA^2 Core Vocabularies), cardinalities and code lists. DE4A WP3 follows an agile approach. The running DE4A pilots will test the properness and validity of the semantic components. Any error or suggested improvement identified during the first iteration are considered at the 2nd iteration of the project as described in the subsequent chapters.

The outcomes of this deliverable, after collaboration and communication with the related work packages, will serve as input to:

▸ The Cross-border Pilots for Citizens and Business and Evaluation (WP4) for running the DE4A pilots.
▸ The Common Component Design & Development (WP5) for designing the first release of the common components and interfaces that will be used for the running pilots.

1.2 Structure of the document

The deliverable is structured as follows:

▸ **Chapter 2** provides an overview of the following: tools and resources, development environments, controlled vocabularies, code lists, canonical evidence development process, and DE4A pilots canonical evidences.
▸ **Chapter 3** presents the implementation of DE4A canonical evidences in XSD format based on data requirements provided as input by the pilots.
▸ **Chapter 4** describes the DE4A semantic model underlying the first iteration of the Information Desk (IDK), along with an initial specification of the corresponding API for accessing information residing in the model.
▸ In **Chapter 5**, the implementation of the DE4A Information Exchange Model is analysed focusing on the designing and development process of the model.
▸ Finally, **Chapter 6** concludes this work and offers future directions of the deliverable.

2 Implementation of Canonical Evidence

Design and implementation of the canonical evidence is a major task carried out by the DE4A WP3. This chapter contains concise descriptions of the implemented common data models that serve as canonical evidence, as required by the three project pilots for cross-border evidence exchange. The data models are constantly improved based on the requirements from the pilot participants as well as taking into account the maturity of the existing resources, primarily from the ISA[2] programme and the Semic SDG-OOP WP4 - Data Semantics, Format and Quality [1]. The status of the canonical evidence descriptions reported here corresponds to the versions as at 28th of February 2021.

For the first and second iteration of the pilots in selected Member States, the following canonical evidences are developed within the DE4A semantic interoperability framework and the toolkit:

1. HigherEducationDiploma (SA)

2. SecondaryEducationDiploma (SA)

3. NonAcademicInformation (SA)

4. CompanyRegistration (DBA)

5. BirthEvidence (MA)

6. MarriageEvidence (MA)

7. DomicileRegistrationEvidence (MA)

8. DomicileDeregistrationEvidence (MA)

9. PensionMeansofLivingEvidence (MA)

10. UnemploymentMeansofLivingEvidence (MA)

11. WorkingLifeMeansofLivivngEvidence (MA)

The basis for the canonical evidences was initially presented in D3.3 *"Semantic Framework - Initial Version"* [2] and in the pilot deliverables for requirement elicitation, i.e., D4.1 *'' Studying Abroad- Use Case Definition & Requirements''[3]*, D4.5 *'' Doing Business Abroad- Use Case Definition & Requirements''*[4], and D4.9 *'' Moving Abroad- Use Case Definition & Requirements''*[5]. The final designs for the canonical evidence models were then presented in D3.4 *"Semantic Framework - Final version"*, based on which this chapter presents the actual implementation of the DE4A semantic aspects. The common data models for the canonical evidence are developed in a continuous co-creation setting together with the semantic experts, domain experts and the member state representatives from each of the piloting teams. An agile approach is followed during the build of the models.

2.1 Tools and Resources

Based on the comparative analysis in D3.5 *"Semantic Toolkit - Initial Version"* [6] regarding the most efficient technologies and resources to be used towards implementing the canonical evidence models, DE4A eventually relies on XML Schema editors for the processes of designing and building the models, and on already established controlled vocabularies and code lists for assigning values to selected properties. This section gives more details on these two aspects.

2.1.1 Development Environments

Since the canonical evidence models are based on the W3C-recommended XML Schema, the partners responsible for the actual implementation of the models used Altova XMLSpy [7], arguably the most popular XML Schema editor. Since this is a commercial tool that requires a paid licence, those partners that did not have one relied on the well-established IDEs Eclipse [8](by the Eclipse Foundation) and IntelliJ [9](by JetBrains) for deploying and validating the XSD models.

2.1.2 Controlled Vocabularies and Code lists

Many element values are constrained to be adapted to agreed EU vocabularies for lists of codes known as **Code lists** or **Controlled Vocabularies**. Based on the requirements and designs presented in D3.2 *"Final requirements for semantic assets"* and D3.4 *"Semantic framework- Final Version"*, respectively, the following table presents the controlled vocabularies and code lists used for the aims of DE4A, also linking each resource to the respective DE4A use case(s) where they were deployed. Table 1 presents the code lists reused during the implementation of the canonical evidences.

<div align="center">Table 1: The Code lists reused in implementing canonical evidences</div>

Code list Name	Description	DE4A Use Case
Cause of end of marriage	The cause of the end of marriage in the marriage evidence.	MA UC2
Country [10]	The Country authority table is a controlled vocabulary that lists concepts associated with names of countries and territories. The concepts included are correlated with the ISO 3166 international standard. ISO 3166-1 contains a two-letter code which is recommended as the general purpose code, a three-letter code which has better mnemonic properties and a numeric-3 code which can be useful if script independence of the codes is important. The authority code relies on the ISO 3166-1/alpha-3 positions. If an authority code is needed for a country without assigned ISO code, an alphanumeric code is created in order to not confuse with ISO codes that are strictly alphabetic or numeric.	MA UC1 MA UC2 DBA UC1 SA UC1
Human Sex [11]	The Human sex authority table is a controlled vocabulary providing the list of human sexes. The Human sex authority table is maintained by the Publications Office of the European Union on the EU Vocabularies website.	MA UC1 MA UC2
Marital Status [12]	As defined in EuroVoc vocabulary.	MA UC1 MA UC2
NUTS / LAU [13]	The NUTS 2021 classification, which will be valid for data transmissions to Eurostat from 1 January 2021, lists 104 regions at NUTS 1, 283 regions at NUTS 2 and 1345 regions at NUTS 3 level. Local Administrative Units (LAUs) are the building blocks of the NUTS, and comprise the municipalities and communes of the European Union.	MA UC1 MA UC2 DBA UC1
Company type [14]	ISO 20275*	DBA UC1

Code list Name	Description	DE4A Use Case
Company activity [15]	NACE* (Nomenclature of Economic Activities) designates the integrated classification system for products and economic activities. It designates the various statistical nomenclatures of economic activities developed since 1970 in the European Union	DBA UC1
Company status [16]	BRIS*	DBA UC1
Language Code [17]	ISO 639-1 - two-letter codes, one per language for ISO 639 macrolanguage	DBA UC1
Main field of study [18]	Specifies the main field of study degree specialization code. ISCED-F (top level) controlled list.	SA UC1
Mode of study [19]	E.g. full-time, part-time etc. Europass Standard List of Learning Schedule Types.	SA UC1
Currency [20]	The Currency authority table is a controlled vocabulary that lists concepts associated with currencies and currency subunits. The concepts included are correlated with the ISO 4217 international standard.	SA UC2 MA UC3

Note: *The code list (*) is not intended to be implemented; only the format is followed as the pilot requested.*

2.2   Canonical Evidences Development Process

The canonical evidences development process is consisted of the three stages illustrated in Figure 1 below. The process is following an incremental development methodology under agile principles. Hence, in this setting, the WP leader plays the role of the product owner, working in a technical working group with the other two technical works packages, WP4 "Cross-border Pilots for Citizens and Business and Evaluation" and WP5 "Common Component Design & Development", following the same development cycles, as described in the DE4A grant agreement. The canonical evidences are co-created together with the users (the piloting member states), allowing the data models created to best fit the requirements of each member state piloting the evidence exchange. The key stages of the process include elicitation, development and evaluation of the data models.
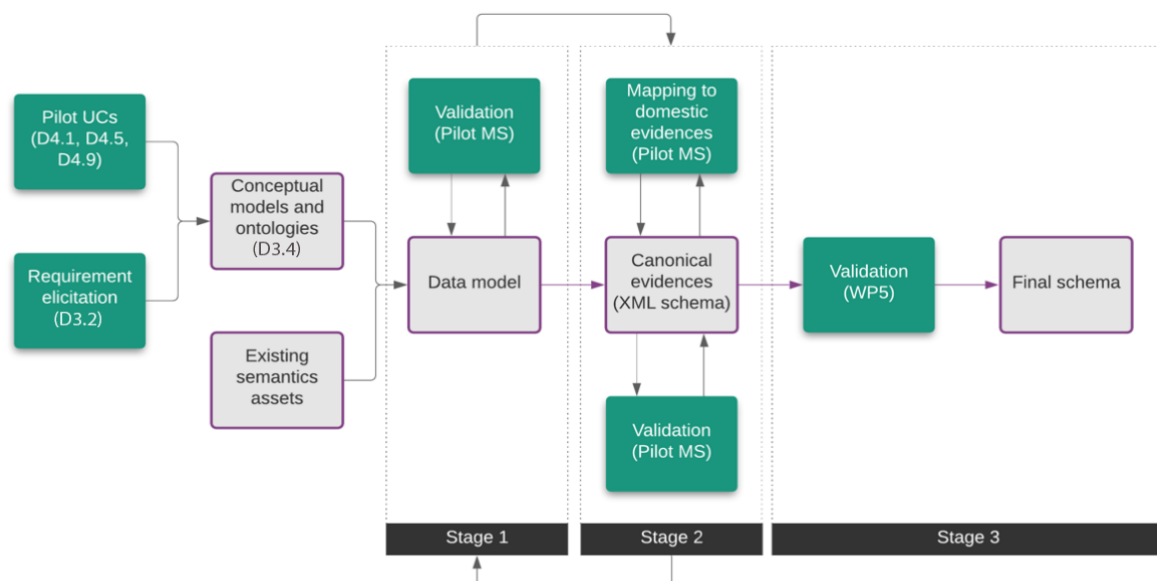
Figure 1: The canonical evidences development process

Accordingly, the preliminary data models are designed based on the existing resources in Stage 1 of the process. The primary models are tested with the piloting member state for model accuracy with respect to the attributes, cardinalities and the affordances of existing vocabularies and code lists. This was an iterative process followed by close dialogue with the respective pilot teams. The XML schemas for the models are developed in Stage 2 in close collaboration with the pilot partners and finally the schemas are validated with the support of WP5 "Common Component Design & Development" during the integration into the technical system.

2.3 Canonical Evidences

Based on the final set of requirements (D3.2 *"Final requirements for semantic assets"*) and the respective design specifications (D3.4 *"Semantic framework- Final version"*), the following subsections present the final implementations of the DE4A canonical evidences.

2.3.1 Studying Abroad Related Canonical Evidence

This subsection presents the implementation of all canonical evidence types for the Study Abroad pilot in DE4A. The objective of the pilot is to simplify the process of a student moving from one European country to another European country to proceed with the studies. The implemented data models are available at DE4A Github Repository [21].

2.3.1.1 Higher Education Completion Evidence

In order to represent the proof of completion of higher education, DE4A implements canonical evidence type **HigherEducationDiplomaType** to indicate that an individual has acquired a higher education diploma. Figure 2 offers a UML diagrammatic overview for this evidence type.
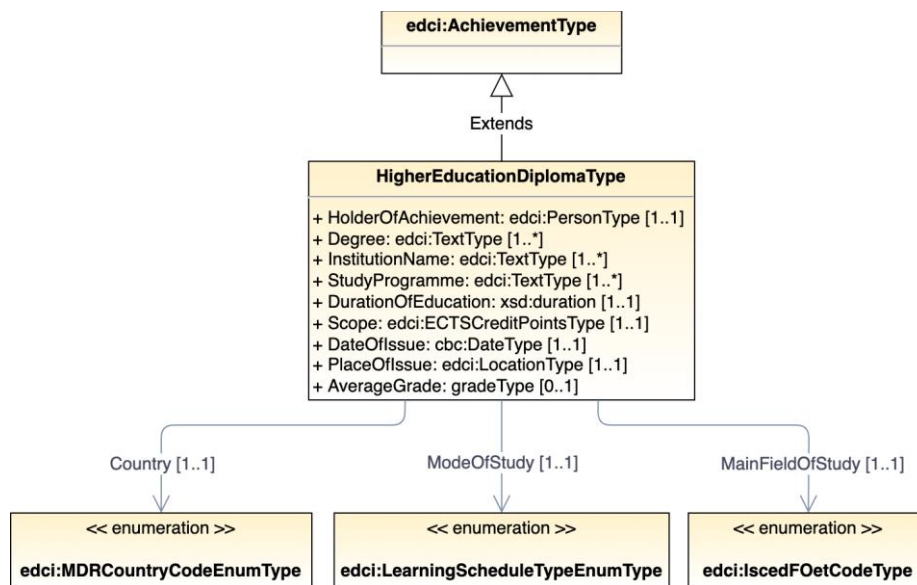
Figure 2: Higher Education Diploma Evidence - UML diagram

As seen in the figure, DE4A largely adopted the EDCI (Europass Digital Credentials Infrastructure) model [21], also relying on CBC (Common Basic Components of the OASIS specification for the Universal Business Language v2.0) [23] for representing dates and on XSD (XML Schema Definition)[24], [25]for representing durations. Table 2 gives a more detailed specification of the attributes.

Table 2: Higher Education Diploma Evidence - Attributes specification

Field	Definition	Data Type	Cardinality
HolderOfAchievement	Person that has obtained the academic title or degree.	edci:PersonType	1..1
Country	Country where the study programme was completed by the student. Takes values from the Country Authority Table codelist.	edci:MDRCountryCodeEnumType	1..1
InstitutionName	The name of the higher education institution where the student obtained the degree.	edci:TextType	1..*
MainFieldOfStudy	Field of finished higher education. Takes values from the ISCED-F controlled list [Table 1]	edci:IscedFOetCodeType	1..1
StudyProgramme	Name of a study programme that the student finished at the higher education institution in order to obtain the degree.	edci:TextType	1..*
Degree	An academic title or degree obtained by the student and proven by this diploma or certificate.	edci:TextType	1..*
DateOfIssue	Date of issue of the certificate or diploma.	cbc:DateType	1..1
PlaceOfIssue	Place of issue (location) of the certificate or diploma.	edci:LocationType	1..1
DurationOfEducation	Official duration of education.	xsd:duration	1..1
ModeOfStudy	Mode of study, e.g., full-time, part-time etc. Takes values from the Europass Standard List of Learning Schedule Types [Table 1]	edci:LearningScheduleTypeEnumType	1..1
Scope	The official workload of the study programme in ECTS credit points.	edci:ECTSCreditPointsType	1..1
AverageGrade	The average grade awarded. Custom type.	gradeType	0..1

Regarding the cardinalities, all fields are considered obligatory, except for the **AverageGrade**, which is optional. Moreover, only one value is allowed for all fields, except from **InstitutionName**, **StudyProgram**, and **Degree**, for which the cardinality permits expressing the respective values in more than one language (e.g., in the local language and in English). Finally, the data type for **AverageGrade** is custom and is an extension to **edci:TextScoreType**, allowing representing the actual score grade, the grading scheme, along with a short textual explanation. Below is a sample XML excerpt for illustrating the use of this custom data type.

```
<averageGrade schemeID="Percentile" explanation="Grading assuming values 0% to 100%, with 100% being the best">94</averageGrade>
```

2.3.1.2   Secondary Education Completion Evidence

In order to represent the proof of completion of secondary education, DE4A implements canonical evidence type **SecondaryEducationDiplomaType** that provides the respective information. Figure 3 offers a UML diagrammatic overview for this evidence type.
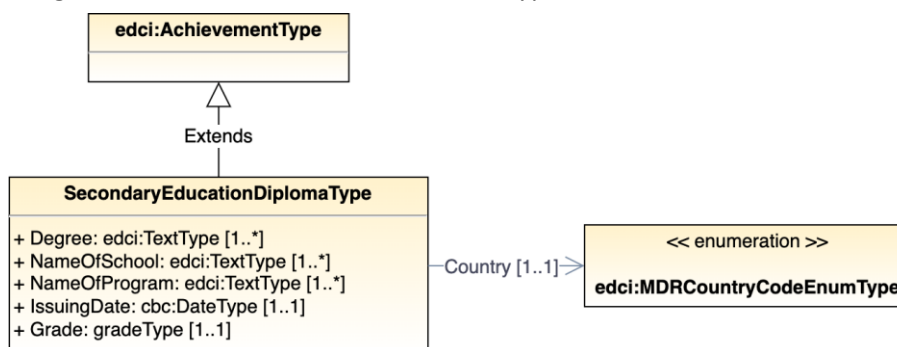
Figure 3: Secondary Education Completion Evidence - UML diagram

As before, DE4A again largely relies on EDCI and CBC/OASIS. Table 3 gives a more detailed specification of the attributes. The **Grade** field assumes the same custom-defined type specified in the previous subsection.

Table 3: Secondary Education Completion Evidence - Attributes specification

Field	Definition	Data Type	Cardinality
Country	Country of completed secondary education. Takes values from the Country Authority Table codelist.	edci:MDRCountryCodeEnumType	1..1
Degree	Degree previously obtained (e.g. General upper secondary education).	edci:TextType	1..*
NameOfSchool	Name of a secondary school that the person finished.	edci:TextType	1..*
NameOfProgram	Name of a secondary school programme that a person successfully finished (e.g. General secondary programme).	edci:TextType	1..*
IssuingDate	Issuing date of the accomplishment.	cbc:DateType	1..1
Grade	Mark indicating a degree of accomplishment. Custom type.	gradeType	0..1

2.3.1.3   Non-Academic Information Evidence

In order to represent non-academic information (e.g., for the purposes of awarding a scholarship or grant), DE4A introduces two canonical evidence types, **HouseholdIncomeType** and **HouseholdCompositionType**, as shown in the following figure.
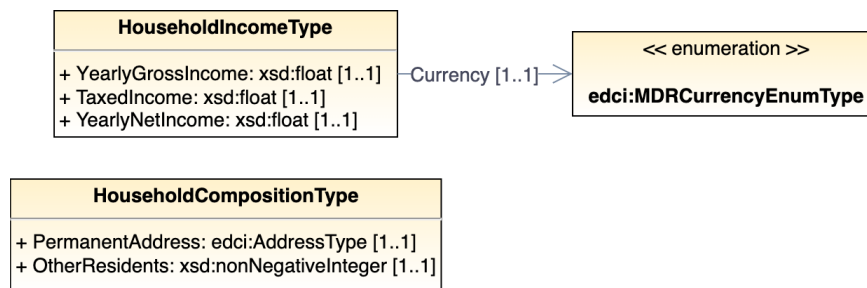
Figure 4: Non-Academic Information Evidence - UML diagram

Table 4 gives a more detailed specification of the attributes.

Table 4: Non-Academic Information Evidence - Attributes specification

Field	Definition	Data Type	Cardinality
Currency	The currency type. Takes values from the Currency authority table codelist.	edci:MDRCurrencyEnumType	1..1
YearlyGrossIncome	The amount of yearly gross income of a household for that tax year.	xsd:float	1..1
TaxedIncome	The amount of income taxed in that tax year.	xsd:float	1..1
YearlyNetIncome	The amount of yearly net income of a household for that tax year.	xsd:float	1..1
PermanentAddress	Address of the permanent residence of the citizen.	edci:AddressType	1..1
OtherResidents	The people they live with.	xsd:nonNegativeInteger	1..1

2.3.2   Doing Business Abroad Related Canonical Evidence

Within the scope of the DE4A project, the Doing Business Abroad pilot (DBA) focuses on two use cases each of which are the most popular on cross-border information exchange, namely, 1) Starting a business in another Member State (UC1) and, 2) Doing business in another Member State (notify and update company data, unsubscribe – UC2).

2.3.2.1   Company Information Evidence

The CompanyRegistration canonical evidence is the only evidence the DBA pilot requires to exchange information across borders in both the use cases. CompanyRegistration evidence is derived from the concepts presented in, Section 4.2, in deliverable D3.4 *"Semantic Framework – Final version"*. Thereby, the concepts are transformed into the attributes required for procedures covering UC1 and UC2. Furthermore, in the initial version, the naming conventions for DE4A concepts are based on the TOOP RegisteredOrganisation ontology, the ISA[2] Core Vocabularies and pilot required data reported in D4.5 *"Doing Business Abroad- Use Case Definition & Requirements"* [4].

For the canonical evidence, the same naming for the attributes is maintained. Attribute descriptions, cardinalities of the attributes, as well as the data types are modified and updated based on the requirements of the countries of the pilot representatives.

During the piloting DBA is using basic data types, hardcoded data and a simple version of the canonical evidence. Therefore, complex data types and code lists were omitted in the current version of the DBA CompanyRegistration evidence.

Following the decisions made in the DE4A technical group, the canonical evidence is implemented in XSD format using XML Schema and the W3C namespace. The canonical evidence has the following main classes:

‣ The legal entity (company) and its branches
‣ The location, address and the contact point of the company
‣ Company's legal name (either in English or in a national language of MS)
‣ The information of zero or more branches of the company

Table 5 below presents the classes and attributes, their data types and cardinalities of the CompanyRegistration evidence.

Table 5: Company information evidence – definitions, data types and cardinalities

Field	Description	Data Type	Cardinality
Legal Entity		Class	1
CompanyName	This is the primary name of the company. Can be provided for multiple languages	NamesType	[1..*]
CompanyType	Type of the company based on ISO 20275 (e.g: SA, PLC, LLC, GmbH etc) [Table 1]	string	[1..1]
CompanyStatus	Company status as defined in BRIS (closed, struck off the register, wound up, dissolved, economically active or inactive)	string	[1..1]
CompanyActivity	The activity of a company	ActivityType	[1..1]
RegistrationDate	Date of registration of the company	date	[1..1]
CompanyEndDate	The company end date	date	[0..1]
CompanyEUID	Identification of the company following the BRIS-structure: country code + register identifier + registration number + verification digit (optional)	string	[1..1]
VatNumber	The VAT registration number of the company	string	[0..*]
CompanyContactData	The contact information of the company (email and Telephone)	ContactPointType	[0..1]
RegisteredAddress	Links a Legal Entity to its registered address	AddressType	[1..*]

Field	Description	Data Type	Cardinality
PostalAddress	Company physical address	AddressType	[0..*]
HasBranch	The branch information	BranchType	[0..1]
Names		**Class**	
LegalEntityName	Legal name of the company	string	[1..1]
ContactPoint		**Class**	
Email	A valid email address of the company	string	[0..*]
Telephone	Telephone number of the company	string	[0..*]
Activity		**Class**	
NaceCode	NACE-code of the company's activities [Table 1]	string	[0..*]
ActivityDescription	Description of the activity	string	[0..*]
Branch		**Class**	
BranchName	Primary name of the branch. Can be provided for multiple languages	NamesType	[1..1]
BranchEUID	Identification of the branch of the company following the BRIS-structure: country code + register identifier + registration number + verification digit (optional)	string	[1..1]
BranchActivity	The activity of the branch presented by the NACE code and description. (NACE) codes are at EU level, however, the documentation claims that its compatible not only translantic but world level.	ActivityType	[0..1]
BranchRegistredAddress	The legal registered address of the branch	AddressType	[1..1]
BranchPostalAddress	The Physical address of the branch	AddressType	[0..1]

Field	Description	Data Type	Cardinality
Address		Class	
PoBox	The Post Office Box number	string	[0..1]
Thoroughfare	The Street name	string	[0..1]
LocationDesignator	House number	string	[0..1]
PostCode	Postal code / zip code	string	[0..1]
PostName	City	string	[0..1]
AdminUnitL2	Administration unit Level2 - County / region / state	string	[0..1]
AdminUnitL1	Country	string	[0..1]

The further up-to-date information about this canonical evidence is presented in the DE4A wiki page [26].

The final version of the XSD implementation of the canonical evidence is presented in the DE4A GitHub repository [21].

2.3.3   Moving Abroad Related Canonical Evidence

The main goal of the Moving Abroad pilot is to facilitate the evidence exchange when citizens are changing of residence from a European country to another European country. The benefits of this will be fewer physical movements of citizens to fetch the evidence and less interventions of civil servants resulting in a faster evidence exchange.

The benefits of DE4A will closely be related to WP5 "Common Component Design & Development "outcomes piloted in WP4 "Common Component Design and Development", where multiple existing (e.g., eIDAS, e-Delivery) and new building blocks will be packaged for their pan-European adoption in the context of OOP and the SDG.

The Moving Abroad ontology presented in deliverable D3.3 *"Semantic Framework – Initial version"* [2] includes the attributes required for procedures covering the UC1 and UC2:

‣ UC1: Registering a change of address (basic registers thematic) – covered by Proof of Residency
‣ UC2: Requesting civil status certificates (population registration thematic) – covered by Birth and Marriage Certificates.

As mentioned in deliverable D3.3 *"Semantic Framework – Initial version"*, Chapter 5, and in deliverable D4.9 *"Moving Abroad - Use Case Definition & Requirements"*, the evidences of UC1 and UC2 are based on the structure public documents foreseen in the Regulation (EU) 2016/1191 [27]of the European Parliament and of the Council of 6 July 2016 on promoting the free movement of citizens by simplifying the requirements for presenting certain public documents in the European Union and amending Regulation (EU) No 1024/2012. Towards representation of standardized forms for the Regulation on Public Documents, ISA developed XML Schema files (XSD). In order to maximize semantic and technical interoperability, these models use existing standards like the ISA[2] Core Vocabularies and the Universal Business Language (UBL) and include a subset of common mandatory attributes between EU Member States and other optional attributes that are MS-specific. UBL is the first standard implementation of ebXML Core Components Technical Specification. The public documents that are related to DE4A pilot use cases are the Birth form (UC2), the Marriage form (UC2) and the Domicile and/or Residence form (UC1).

As a starting point, for the purpose of the Minimum Viable Product for the first iteration, the project will implement the canonical evidence types that facilitate the exchange of the minimum set of common attributes between EU Member States that are required for the procedure.

However, directly reusing the ISA XSD files for public documents for the canonical evidence is not feasible. The main reason is that these schemas are about representing PDF or XML forms but not evidence, violating the DE4A data minimisation principle for cross-border evidence exchange. These schemas contain metadata for the document (e.g., header, footer and document information) that is not directly needed for the procedure. Furthermore, apart from the common mandatory attributes identified by ISA, there are also optional attributes (e.g., parent details in birth certificate) with different naming conventions in each country but referring to the same concept. Therefore, it has been decided to reuse the current version of evidence data models by SDG Work Package 4 - Data Semantics, Formats & Quality [1] that defined common data formats for evidence types based on the EU Regulation for Public Documents. These formats for evidence types include the birth and marriage certificates that are related to UC2 for moving abroad. After an extensive study on the SDG models and ISA XSD files, it was observed that the attributes of SDG models are indeed a subset of the ISA XSD files for Public Documents.

For the canonical evidence, the same attribute naming conventions to the SDG models with the same data types (based on the ISA^2 Core Vocabularies) and cardinalities are used. During the first iteration of the pilots (with the MVP) the pilots are using basic data types, hardcoded data and a simple version of the canonical evidence. Therefore, complex data types and code lists were omitted in the current version of the evidences.

Following the recommendations for the DE4A technical implementation, the canonical evidence is implemented in XSD format using the XML Schema and the W3C namespace.

2.3.3.1   Birth Evidence

For the birth certificate, the current version of the respective SDG model is reused. Apart from the representation of PDF and XML documents by ISA XSD files, the main difference between the SDG model for the birth certificate and the ISA XSD files is the common optional attributes identified by SDG. Moreover, there are some minor differences on the structure of the evidence (e.g., the birth event in SDG model includes the parent and the child as object properties while in the ISA XSD files the birth event includes only the birth person as an object property and the parent is an object property of the birth person) but the concepts remain the same. The following figure offers a UML diagrammatic overview for this evidence type.
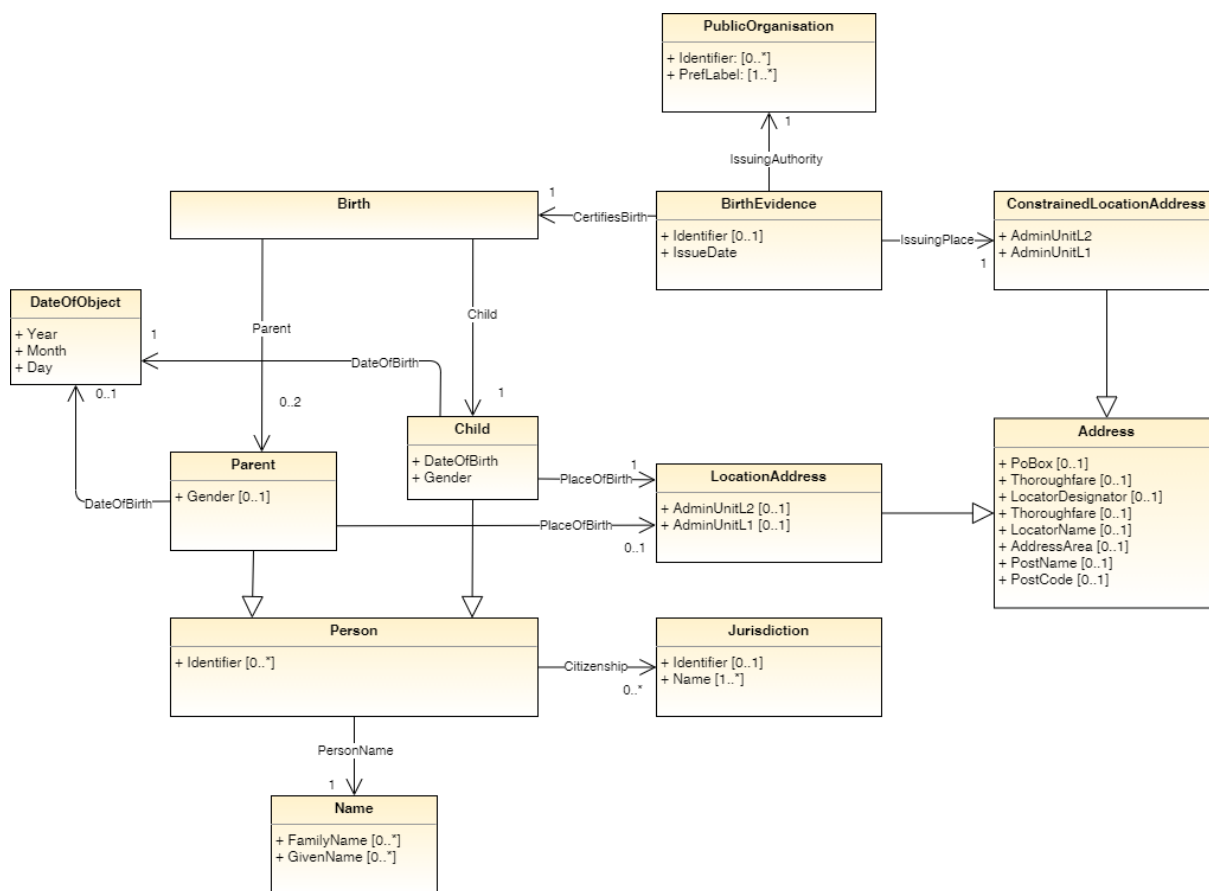
Figure 5: UML diagram for birth evidence

Birth Evidence model is analysed in Table 6 below where classes and properties are presented with their data types and cardinalities.

Table 6: Birth Evidence model-attributes specification

Field	Description	Data Type	Cardinality
BirthEvidence	Official document or data proving the Birth of a Child.	BirthEvidenceType	
Identifier	An unambiguous reference to the Birth Evidence.	cva:CvidentifierType	[0..1]
IssueDate	The most recent date on which the Birth Evidence instance was issued.	udt:DateType	[1..1]
IssuingAuthority	A Public Organisation with official authority in charge of issuing the Birth Evidence.	PublicOrganisationType	[1..1]
IssuingPlace	The Location where the Birth Evidence was issued.	ConstrainedLocationAddressType	[1..1]
CertifiesBirth	Attesting in a formal way that the Birth is true.	BirthType	[1..1]
PublicOrganization	Any organisation that is defined as being part of the public sector by a legal framework at any level.		

Field	Description	Data Type	Cardinality
Identifier	Many organisations are referred to by an acronym or some other identifier. For example, among the EU institutions, the ECB is the identifier for the European Central Bank, OLAF for the European Anti-Fraud Office, and so on. These are formally recognised by the European Commission which provides a list of such acronyms. Analogous lists should be used in other contexts.	cva:CvidentifierType	[0..*]
PrefLabel	As defined in the ORG Ontology, a preferred label is used to provide the primary, legally recognised name of the organisation. An organisation may only have one such name in any given language. Primary names may be provided in multiple languages with multiple instances of the preferred label property.	udt:Text	[1..*]
Birth	The event indicating the moment a Child emerges from the body of another Person, i.e. start of life.		
Child	The Person who is born at the Birth.	ChildType	[1..1]
Parent	The Parent of the Child.	ParentType	[0..2]
Child	A Person of any age, who is a son or daughter.		
DateOfBirth	The day on which the Child was born.	DateObjectType	[1..1]
Gender	The gender of the person.	Code	[1..1]
PlaceOfBirth	The Location where the Child was born.	LocationAddressType	[1..1]
Parent	One of the two Persons who are jointly the cause of the Child's Birth, i.e. natural parent.		
DateOfBirth	The day on which the Parent was born.	DateObjectType	[0..1]
Gender	The gender of the person.	Human Sex [Table 1]	[0..1]
PlaceOfBirth	The Location where the Parent was born.	LocationAddressType	[0..1]
Person	An individual natural person who may be dead or alive, but not imaginary.		
PersonName	The family name and given name of a Person. At least one of the two must exist.	NameType	[1..1]

Field	Description	Data Type	Cardinality
Identifier	The identifier relation is used to link a Person to any formally issued Identifier for that Person.	cva:CvidentifierType	[0..*]
Citizenship	The citizenship relationship links a Person to a Jurisdiction that has conferred citizenship rights on the individual such as the right to vote, to receive certain protection from the community or the issuance of a passport.	JurisdictionType	[0..*]
Jurisdiction	The authority that an official organisation has, to make legal decisions about somebody/something.		
Identifier	The value for the id property is a URI for that Jurisdiction.	cvb:JurisdictionIDType	[0..1]
Name	The name is simply a string that identifies the Jurisdiction, typically a country, with or without a language tag.	Country [Table 1]	[1..*]
ConstrainedLocationAddress	The Address of a location based on the INSPIRE Address representation. It is subclass of the class Address.		
AdminUnitL2	The region of the address, usually a county, state or other such area that typically encompasses several localities.	cvb:AdminunitSecondlineType	[1..1]
AdminUnitL1	The uppermost administrative unit for the address, almost always a country. Best practice is to use the ISO 3166-1 code.	Country [Table 1]	[1..1]
LocationAddress	The Address of the place of birth based on the INSPIRE Address representation. It is subclass of the class Address.		
AdminUnitL2	The region of the address, usually a county, state or other such area that typically encompasses several localities.	cvb:AdminunitSecondlineType	[0..1]
AdminUnitL1	The uppermost administrative unit for the address, almost always a country. Best practice is to use the ISO 3166-1 code.	Country [Table 1]	[0..1]
Address	Representation of address based on the INSPIRE Address Representation.		
PoBox	The Post Office Box number. INSPIRE's name for this is	cvb:PoBoxType	[0..1]

Field	Description	Data Type	Cardinality
	"postalDeliveryIdentifier" for which it uses the locator designator property with a type attribute of that name. This vocabulary separates out the Post Office Box for greater independence of technology.		
Thoroughfare	Quoting from the INSPIRE guidelines, a thoroughfare is: "an address component that represents the name of a passage or way through from one location to another. A thoroughfare is not necessarily a road, it might be a waterway or some other feature.	cvb:ThoroughfareType	[0..1]
LocatorDesignator	The locator designator is defined by the INSPIRE guidelines as "a number or a sequence of characters that uniquely identifies the locator within the relevant scope(s). The full identification of the locator could include one or more locator designators." In simpler terms, this is the building number, apartment number, etc. For an address such as "Flat 3, 17 Bridge Street", the locator is "flat 3, 17."	cvb:LocatorDesignatorType	[0..1]
LocatorName	Based on the INSPIRE guidelines, locator name is defined as: "Proper noun(s) applied to the real world entity identified by the locator. The locator name could be the name of the property or complex, of the building or part of the building, or it could be the name of a room inside a building. The key difference between a locator and a locator name is that the latter is a proper name and is unlikely to include digits. For example, "Shumann, Berlaymont" is a meeting room within the European Commission headquarters for which locator name is more appropriate than locator.	cvb:LocatorNameType	[0..1]
AddressArea	Taking the definition from INSPIRE, the address area is: the name or names of a geographic area or locality that groups a number of addressable objects for addressing purposes, without being an administrative unit."	cvb:CvaddressAreaType	[0..1]

Field	Description	Data Type	Cardinality
	This would typically be part of a city, a neighbourhood or village.		
PostName	The key postal division of the address, usually the city. (INSPIRE's definition is "One or more names created and maintained for postal purposes to identify a subdivision of addresses and postal delivery points.)	cvb:PostNameType	[0..1]
PostCode	The post code (a.k.a postal code, zip code etc.). Post codes are common elements in many countries' postal address systems.	cvb:PostCodeType	[0..1]
DateObject	**Structured representation of date with year, month and day of the month.**		
Year	A Gregorian calendar year. The value space of Year is the set of Gregorian calendar years as defined in § 5.2.1 of ISO 8601. Specifically, it is a set of one-year long, non-periodic instances e.g. lexical 1999 to represent the whole year 1999, independent of how many months and days this year has.	xsd:gYear	[0..1]
Month	A Gregorian month that recurs every year. The value space of Month is the space of a set of calendar months as defined in § 3 of ISO 8601. Specifically, it is a set of one-month long, yearly periodic instances.	xsd:gMonth	[0..1]
Day	A Gregorian day that recurs, specifically a day of the month such as the 5th of the month. The value space of Day is the space of a set of calendar dates as defined in § 3 of ISO 8601. Specifically, it is a set of one-day long, monthly periodic instances.	xsd:gDay	[0..1]
Name	**A name of a person that includes the family and given name.**		
FamilyName	A family name is usually shared by members of a family. This attribute also carries prefixes or suffixes which are part of the family name, e.g. "de Boer", "van de Putte", "von und zu Orlow". Multiple family names, such as are commonly found in Hispanic countries, are recorded in the single family name field so that, for example, Miguel de Cervantes Saavedra's Family	cbc:FamilyNameType	[0..*]

Field	Description	Data Type	Cardinality
	Name would be recorded as "de Cervantes Saavedra".		
GivenName	A given name, or multiple given names, are the denominator(s) that identify an individual within a family. These are given to a Person by his or her parents at birth or may be legally recognised as 'given names' through a formal process. All given names are ordered in one field so that, for example, the given name for Johann Sebastian Bach is 'Johann Sebastian'.	cvb:GivenNameType	[0..*]

2.3.3.2 Marriage Evidence

For the marriage certificate, the current version of the respective SDG model [1] is reused. Apart from the representation of PDF and XML documents by ISA XSD files, the main difference between the SDG model for the marriage certificate and the ISA XSD files is the common optional attributes identified by SDG. Moreover, there are some minor differences on the cardinalities, where SDG identifies that in specific countries some attributes are considered optional (e.g., placeOfMarriage, familyNameAfterMarriage, familyNameBeforeMarriage) but the concepts remain the same. Figure 6 offers a UML diagrammatic overview for this evidence type.
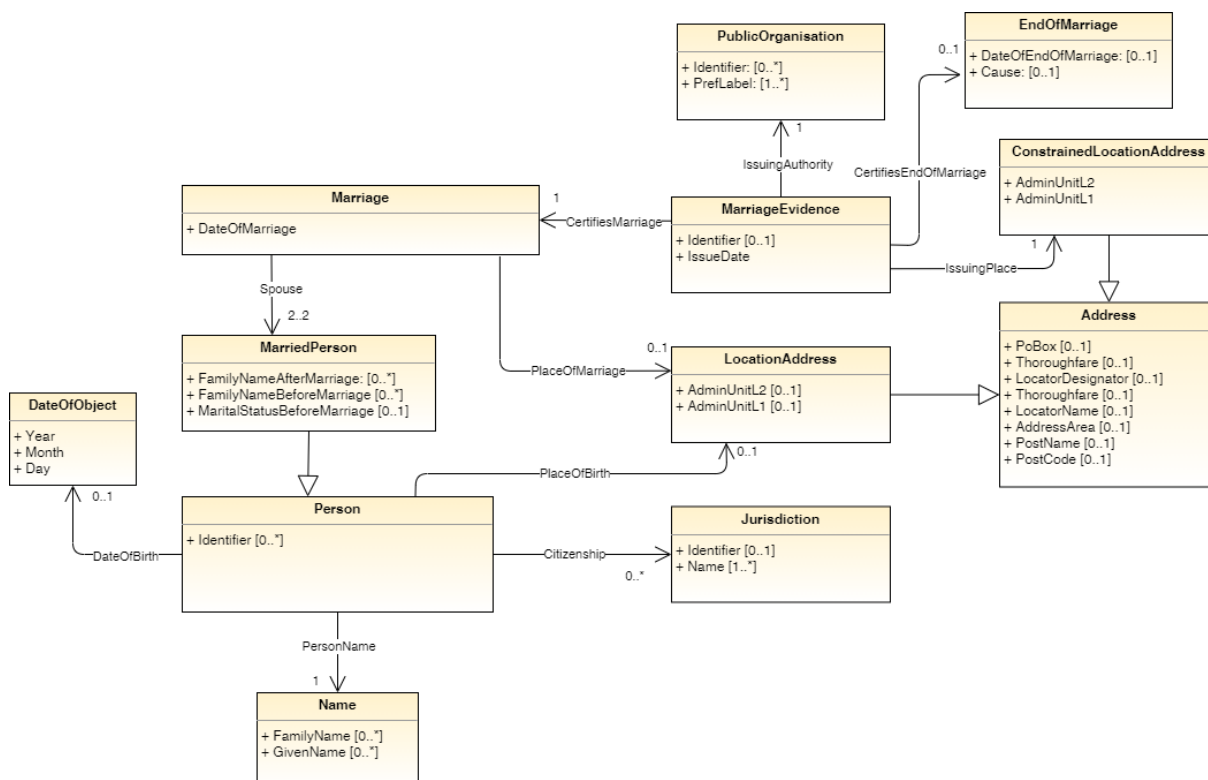
Figure 6: UML diagram for the Marriage Evidence

Marriage Evidence model is analysed in Table 7 where classes and properties are presented with their data types and cardinalities.

Table 7: Marriage Evidence model- attributes specification

Field	Description	Data Type	Cardinality
MarriageEvidence	Official document or data proving the Marriage of two Persons.		
Identifier	An unambiguous reference to the Marriage Evidence.	cva:CvidentifierType	[0..1]
IssueDate	The most recent date on which the Marriage Evidence instance was issued.	udt:DateType	[1..1]
IssuingAuthority	A Public Organisation with official authority in charge of issuing the Marriage Evidence.	PublicOrganisation Type	[1..1]
IssuingPlace	The Location where the Marriage Evidence was issued.	ConstrainedLocatio nAddressType	[1..1]
CertifiesMarriage	Attesting in a formal way that the Marriage is true.	MarriageType	[1..1]
CertifiesEndOfMarriage	In case of divorce, this property includes information on the end of marriage	EndOfMarriageTyp e	[0..1]
PublicOrganisation	Any organisation that is defined as being part of the public sector by a legal framework at any level.		
Identifier	Many organisations are referred to by an acronym or some other identifier. For example, among the EU institutions, the ECB is the identifier for the European Central Bank, OLAF for the European Anti-Fraud Office, and so on. These are formally recognised by the European Commission which provides a list of such acronyms. Analogous lists should be used in other contexts.	cva:CvidentifierType	[0..*]
PrefLabel	As defined in the ORG Ontology, a preferred label is used to provide the primary, legally recognised name of the organisation. An organisation may only have one such name in any given language. Primary names may be provided in multiple languages with multiple instances of the preferred label property.	udt:TextType	[1..*]

Field	Description	Data Type	Cardinality
Marriage	A legally accepted relationship between two Persons in which they live together.		
DateOfMarriage	The date on which the Marriage took place.	udt:DateType	[1..1]
Spouse	The Person who was married.	MarriedPersonType	[2..2]
PlaceOfMarriage	The Location where the Marriage took place.	LocationAddressType	[0..1]
MarriedPerson	A Person who has entered into a Marriage.		
FamilyNameAfterMarriage	This property contains the family name after the Marriage of the Person.	udt:TextType	[0..*]
FamilyNameBeforeMarriage	This property contains the family name before the Marriage of the Person.	udt:TextType	[0..*]
MaritalStatusBeforeMarriage	Situation with regard to whether a Person was single, married, separated, divorced or widowed.	Marital Status [Table 1]	[0..1]
Person	An individual natural person who may be dead or alive, but not imaginary.		
DateOfBirth	The day on which the Person was born.	DateObjectType	[0..1]
PersonName	The family name and given name of a Person. At least one of the two must exist.	NameType	[1..1]
Identifier	The identifier relation is used to link a Person to any formally issued Identifier for that Person.	cva:CvidentifierType	[0..*]
PlaceOfBirth	The Location where the Person was born.	LocationAddressType	[0..1]
Gender	The gender of the person.	Human Sex [Table 1]	[1..1]
Citizenship	The citizenship relationship links a Person to a Jurisdiction that has conferred citizenship rights on the individual such as the right to vote, to receive certain protection from the community or the issuance of a passport.	JurisdictionType	[0..*]
Jurisdiction	The authority that an official organisation has, to make legal		

Field	Description	Data Type	Cardinality
	decisions about somebody/something.		
Identifier	The value for the id property is a URI for that Jurisdiction.	cvb:JurisdictionIDType	[0..1]
Name	The name is simply a string that identifies the Jurisdiction, typically a country, with or without a language tag.	Country [Table 1]	[1..*]
ConstrainedLocationAddress	The Address of a location based on the INSPIRE Address representation. It is subclass of the class Address.		
AdminUnitL2	The region of the address, usually a county, state or other such area that typically encompasses several localities.	cvb:AdminunitSecondlineType	[1..1]
AdminUnitL1	The uppermost administrative unit for the address, almost always a country. Best practice is to use the ISO 3166-1 code.	Country [Table 1]	[1..1]
LocationAddress	The Address of the place of birth based on the INSPIRE Address representation. It is subclass of the class Address.		
AdminUnitL2	The region of the address, usually a county, state or other such area that typically encompasses several localities.	cvb:AdminunitSecondlineType	[0..1]
AdminUnitL1	The uppermost administrative unit for the address, almost always a country. Best practice is to use the ISO 3166-1 code.	Country [Table 1]	[0..1]
Address	Representation of address based on the INSPIRE Address Representation.		
PoBox	The Post Office Box number. INSPIRE's name for this is "postalDeliveryIdentifier" for which it uses the locator designator property with a type attribute of that name. This vocabulary separates out the Post Office Box for greater independence of technology.	cvb:PoBoxType	[0..1]
Thoroughfare	Quoting from the INSPIRE guidelines, a thoroughfare is: "an	cvb:ThoroughfareType	[0..1]

Field	Description	Data Type	Cardinality
	address component that represents the name of a passage or way through from one location to another. A thoroughfare is not necessarily a road, it might be a waterway or some other feature.		
LocatorDesignator	The locator designator is defined by the INSPIRE guidelines as "a number or a sequence of characters that uniquely identifies the locator within the relevant scope(s). The full identification of the locator could include one or more locator designators." In simpler terms, this is the building number, apartment number, etc. For an address such as "Flat 3, 17 Bridge Street", the locator is "flat 3, 17."	cvb:LocatorDesignatorType	[0..1]
LocatorName	Based on the INSPIRE guidelines, locator name is defined as: "Proper noun(s) applied to the real-world entity identified by the locator. The locator name could be the name of the property or complex, of the building or part of the building, or it could be the name of a room inside a building. The key difference between a locator and a locator name is that the latter is a proper name and is unlikely to include digits. For example, "Shumann, Berlaymont" is a meeting room within the European Commission headquarters for which locator name is more appropriate than locator.	cvb:LocatorNameType	[0..1]
AddressArea	Taking the definition from INSPIRE, the address area is "the name or names of a geographic area or locality that groups a number of addressable objects for addressing purposes, without being an administrative unit." This would typically be part of a city, a neighbourhood or village.	cvb:CvaddressAreaType	[0..1]

Field	Description	Data Type	Cardinality
PostName	The key postal division of the address, usually the city. (INSPIRE's definition is "One or more names created and maintained for postal purposes to identify a subdivision of addresses and postal delivery points.)	cvb:PostNameType	[0..1]
PostCode	The post code (a.k.a. postal code, zip code etc.). Post codes are common elements in many countries' postal address systems.	cvb:PostCodeType	[0..1]
EndOfMarriage	Date and cause of end of marriage		
DateOfEndOfMarriage		udt:DateType	[0..1]
Cause		udt:TextType	[0..1]
DateObject	Structured representation of date with year, month and day of the month.		
Year	A Gregorian calendar year. The value space of Year is the set of Gregorian calendar years as defined in § 5.2.1 of ISO 8601. Specifically, it is a set of one-year long, non-periodic instances e.g. lexical 1999 to represent the whole year 1999, independent of how many months and days this year has.	xsd:gYear	[0..1]
Month	A Gregorian month that recurs every year. The value space of Month is the space of a set of calendar months as defined in § 3 of ISO 8601. Specifically, it is a set of one-month long, yearly periodic instances.	xsd:gMonth	[0..1]
Day	A Gregorian day that recurs, specifically a day of the month such as the 5th of the month. The value space of Day is the space of a set of calendar dates as defined in § 3 of ISO 8601. Specifically, it is a set of one-day long, monthly periodic instances.	xsd:gDay	[0..1]
Name	A name of a person that includes the family and given name.		
FamilyName	A family name is usually shared by members of a family. This	cbc:FamilyNameType	[0..*]

Field	Description	Data Type	Cardinality
	attribute also carries prefixes or suffixes which are part of the family name, e.g., "de Boer", "van de Putte", "von und zu Orlow". Multiple family names, such as are commonly found in Hispanic countries, are recorded in the single family name field so that, for example, Miguel de Cervantes Saavedra's Family Name would be recorded as "de Cervantes Saavedra".		
GivenName	A given name, or multiple given names, are the denominator(s) that identify an individual within a family. These are given to a Person by his or her parents at birth or may be legally recognised as 'given names' through a formal process. All given names are ordered in one field so that, for example, the given name for Johann Sebastian Bach is 'Johann Sebastian'.	cvb:GivenNameType	[0..*]

2.3.3.3 Domicile Registration Evidence

For the proof of residence, there is no SDG model available. The relevant information is provided by the Domicile and/or Residence form from Annex X of EU Regulation for Public Documents. Nevertheless [27], the common attributes (mandatory and optional with different naming conventions) share many similarities with the Birth and Marriage certificates. Therefore, it was decided to use the same structure with Birth and Marriage certificates so that all canonical evidence types in the Moving Abroad pilot share the same structure and to align as much as possible with the SDG and ISA XSD files. Figure 7 offers a UML diagrammatic overview for this evidence type.
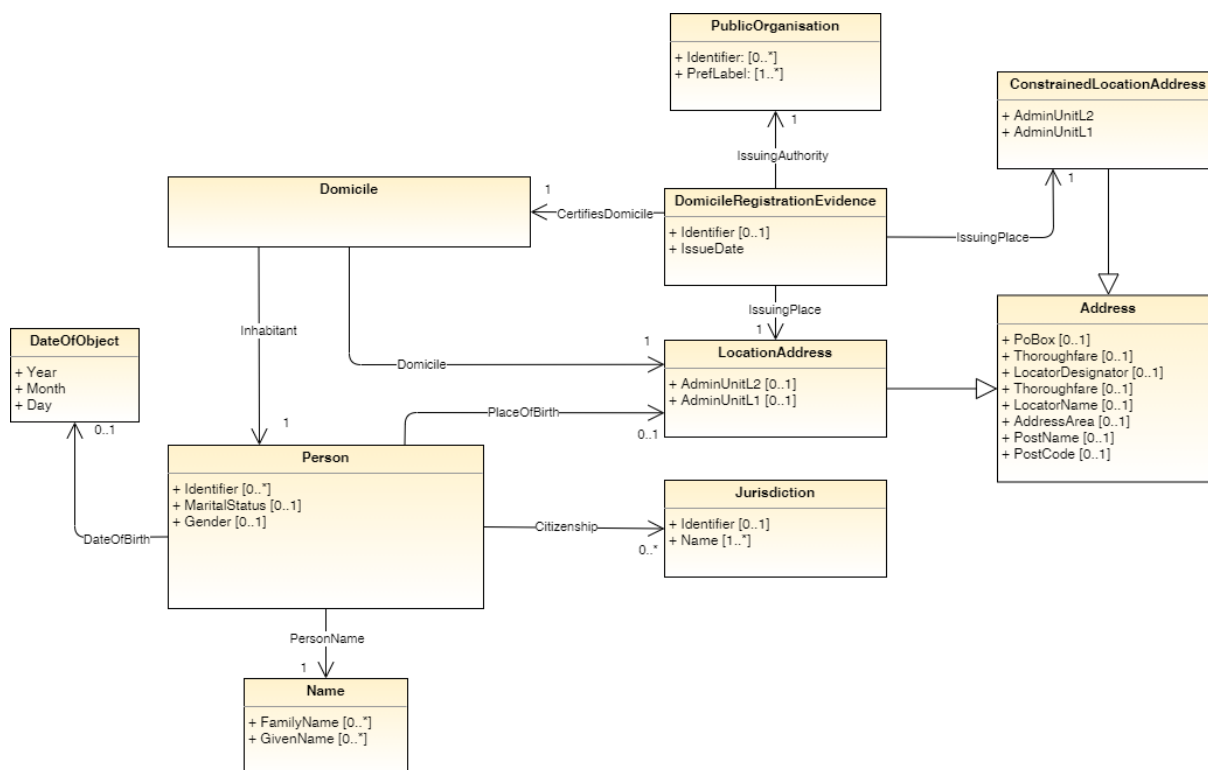
Figure 7: UML diagram for the Domicile Registration Evidence

The models are analysed in table below, based on the identified concepts by ISA XSD files and the structure of SDG evidence data models, where classes and properties are presented with their data types and cardinalities. Note the many optional elements to compensate for the fact that not all data is obtainable in all countries.

Table 8: Domicile Registration Evidence- attributes specifications

Field	Description	Data Type	Cardinality
DomicileRegistrationEvidence	This class contains elements related to the Domicile Registration Evidence.		
Identifier	An unambiguous reference to the Domicile Registration Evidence.	cva:CvidentifierType	[0..1]
IssueDate	The most recent date on which the Domicile Registration Evidence instance was issued.	udt:DateType	[1..1]
IssuingAuthority	A Public Organisation with official authority in charge of issuing the Domicile Registration Evidence.	PublicOrganisationType	[1..1]
IssuingPlace	The location address where the Domicile Registration Evidence was issued.	LocationAddressType	[1..1]
CertifiesDomicile	Attesting in a formal way that the Domicile is true.	DomicileType	[1..1]

Field PublicOrganisation	Description Any organisation that is defined as being part of the public sector by a legal framework at any level.	Data Type	Cardinality
Identifier	Many organisations are referred to by an acronym or some other identifier. For example, among the EU institutions, the ECB is the identifier for the European Central Bank, OLAF for the European Anti-Fraud Office, and so on. These are formally recognised by the European Commission which provides a list of such acronyms. Analogous lists should be used in other contexts.	cva:CvidentifierType	[0..*]
PrefLabel	As defined in the ORG Ontology, a preferred label is used to provide the primary, legally recognised name of the organisation. An organisation may only have one such name in any given language. Primary names may be provided in multiple languages with multiple instances of the preferred label property.	udt:TextType	[1..*]
Domicile	This class contains elements related to the domicile		
Inhabitant	Person, living in the residence or domicile	PersonType	[1..1]
Domicile	Current domicile inhabited by person	ConstrainedLocation AddressType	[1..1]
Person	An individual natural person who may be dead or alive, but not imaginary.		
PersonName	The family name and given name of a Person. At least one of the two must exist.	NameType	[1..1]
Identifier	The identifier relation is used to link a Person to any formally issued Identifier for that Person.	cva:CvidentifierType	[0..*]
DateOfBirth	The day on which the person was born.	DateObjectType	[0..1]
Gender	The gender of the person.	Human Sex [Table 1]	[0..1]
MaritalStatus	An indicator of the marital status	Marital Status	[0..1]

Field	Description	Data Type	Cardinality
		[Table 1]	
PlaceOfBirth	The Location where the person was born	LocationAddressType	[0..1]
Citizenship	The citizenship relationship links a Person to a Jurisdiction that has conferred citizenship rights on the individual such as the right to vote, to receive certain protection from the community or the issuance of a passport.	JurisdictionType	[0..*]
Jurisdiction	The authority that an official organisation has, to make legal decisions about somebody/something.		
Identifier	The value for the id property is a URI for that Jurisdiction.	cvb:JurisdictionIDType	[0..1]
Name	The name is simply a string that identifies the Jurisdiction, typically a country, with or without a language tag.	Country [Table 1]	[1..*]
ConstrainedLocationAddress	The Address of a location based on the INSPIRE Address representation. It is subclass of the class Address.		
AdminUnitL2	The region of the address, usually a county, state or other such area that typically encompasses several localities.	cvb:AdminunitSecondlineType	[1..1]
AdminUnitL1	The uppermost administrative unit for the address, almost always a country. Best practice is to use the ISO 3166-1 code.	Country [Table 1]	[1..1]
LocationAddress	The Address of the place of birth based on the INSPIRE Address representation. It is subclass of the class Address.		
AdminUnitL2	The region of the address, usually a county, state or other such area that typically encompasses several localities.	cvb:AdminunitSecondlineType	[0..1]
AdminUnitL1	The uppermost administrative unit for the address, almost always a country. Best practice is to use the ISO 3166-1 code.	Country [Table 1]	[0..1]

Field Address	Description Representation of address based on the INSPIRE Address Representation.	Data Type	Cardinality
PoBox	The Post Office Box number. INSPIRE's name for this is "postalDeliveryIdentifier" for which it uses the locator designator property with a type attribute of that name. This vocabulary separates out the Post Office Box for greater independence of technology.	cvb:PoBoxType	[0..1]
Thoroughfare	Quoting from the INSPIRE guidelines, a thoroughfare is: "an address component that represents the name of a passage or way through from one location to another. A thoroughfare is not necessarily a road, it might be a waterway or some other feature.	cvb:ThoroughfareType	[0..1]
LocatorDesignator	The locator designator is defined by the INSPIRE guidelines as "a number or a sequence of characters that uniquely identifies the locator within the relevant scope(s). The full identification of the locator could include one or more locator designators." In simpler terms, this is the building number, apartment number, etc. For an address such as "Flat 3, 17 Bridge Street", the locator is "flat 3, 17."	cvb:LocatorDesignatorType	[0..1]
LocatorName	Based on the INSPIRE guidelines, locator name is defined as: "Proper noun(s) applied to the real-world entity identified by the locator. The locator name could be the name of the property or complex, of the building or part of the building, or it could be the name of a room inside a building. The key difference between a locator and a locator name is that the latter is a proper name and is unlikely to include digits. For example, "Shumann, Berlaymont" is a meeting room within the	cvb:LocatorNameType	[0..1]

Field	Description	Data Type	Cardinality
	European Commission headquarters for which locator name is more appropriate than locator.		
AddressArea	Taking the definition from INSPIRE, the address area is "the name or names of a geographic area or locality that groups a number of addressable objects for addressing purposes, without being an administrative unit." This would typically be part of a city, a neighbourhood or village.	cvb:CvaddressAreaType	[0..1]
PostName	The key postal division of the address, usually the city. (INSPIRE's definition is "One or more names created and maintained for postal purposes to identify a subdivision of addresses and postal delivery points.)	cvb:PostNameType	[0..1]
PostCode	The post code (a.k.a. postal code, zip code etc.). Post codes are common elements in many countries' postal address systems.	cvb:PostCodeType	[0..1]
Name	**A name of a person that includes the family and given name.**		
FamilyName	A family name is usually shared by members of a family. This attribute also carries prefixes or suffixes which are part of the family name, e.g., "de Boer", "van de Putte", "von und zu Orlow". Multiple family names, such as are commonly found in Hispanic countries, are recorded in the single family name field so that, for example, Miguel de Cervantes Saavedra's Family Name would be recorded as "de Cervantes Saavedra".	cbc:FamilyNameType	[0..*]
GivenName	A given name, or multiple given names, are the denominator(s) that identify an individual within a family. These are given to a Person by his or her parents at birth or may be legally recognised as 'given names' through a formal	cvb:GivenNameType	[0..*]

Field	Description	Data Type	Cardinality
	process. All given names are ordered in one field so that, for example, the given name for Johann Sebastian Bach is 'Johann Sebastian'.		

2.3.3.4   Means of Living Canonical Evidence Types

As part of the second iteration of the project and for the scope of the Use Case "UC3 Request Pension Information – Claim Pension", three canonical evidence types are implemented for different means of living: Pension, Unemployment and Working life. The discussions for the design of these data models are based on the specific case where a person from Spain (data owner) claims pension in Portugal (data evaluator) that will take place for the Moving Abroad pilot.

2.3.3.4.1   Pension Means of Living Evidence

The Pension Means of Living Evidence holds information on the pension benefits. The model of this type of evidence is analysed in Table 9 where classes and properties are presented with their data types and cardinalities.

Table 9: Pension Means of Living Evidence-attributes specifications

Field	Description	Data Type	Cardinality
PensionMeansOfLiving Evidence			
Identifier	An unambiguous reference to the Pension Means of Living Evidence	cva:CvidentifierType	[0..1]
IssueDate	The most recent date on which the Pension Means of Living Evidence instance was issued.	udt:DateType	[1..1]
IssuingAuthority	A Public Organisation with official authority in charge of issuing the Pension Means of Living Evidence.	PublicOrganisationType	[1..1]
Certifies	Attesting in a formal way that the pension data is true.	PensionMeansOfLiving InfoType	[1..1]
PublicOrganisation	Any organisation that is defined as being part of the public sector by a legal framework at any level.		
Identifier	Many organisations are referred to by an acronym or some other identifier. For example, among the EU institutions, the ECB is the identifier for the European Central Bank, OLAF for the European Anti-Fraud Office, and so on. These are formally recognised by the European Commission which provides a list of such acronyms.	cva:CvidentifierType	[0..*]

Field	Description	Data Type	Cardinality
	Analogous lists should be used in other contexts.		
PrefLabel	As defined in the ORG Ontology, a preferred label is used to provide the primary, legally recognised name of the organisation. An organisation may only have one such name in any given language. Primary names may be provided in multiple languages with multiple instances of the preferred label property.	udt:TextType	[1..*]
PensionMeansOfLivingInfo	Information on different pension benefits		
DataSubject	The person who is subject to this information	PersonType	[1..1]
PensionList	List of pensions and benefits. Contains information on the pensions of the person for whom the query was made.	PensionListType	[0..1]
PensionList			
Pension	Contains detailed data about each specific pension.	PensionType	[1..*]
Pension			
PensionCategory	Literals of the specific codes of the Spanish pension system. The possible values are listed in tab "Pensions".	PensionCategoryEnum	[1..1]
Status	Status of the benefit. The possible values are: ▸ ACTIVE: the citizen is receiving the unemployment benefit ▸ NON-ACTIVE: the citizen is not receiving the unemployment benefit ▸ NON-ACTIVE due to APRE (APRE: "Cumulative and early payment of contributory unemployment benefit to foreign workers returning to their country of origin") ▸ NON-ACTIVE when the benefit has been capitalised	StatusTypeEnum	[1..1]
GrossAmount	The amount of the benefit, including the amounts of possible	MonetaryAmountType	[0..1]

Field	Description	Data Type	Cardinality
	deductions plus the amount of Personal Income Tax (if applicable). There may be benefits with a gross amount equal to zero. For all social public benefits, the monthly amount of the benefit as at the date of consultation will be returned. For M6 or P6 direct payment benefits, the gross amount will be the amount that will be paid for the whole benefit even if it has not yet been paid. For temporary disability (direct payment benefit I6 or I7), the gross amount will be the amount that has been paid up to the time of the consultation. If there are confirmation statements captured but not paid, the payment will be calculated and included in the gross amount. Amount in euro cents. The format is NNNNNNN		
NetAmount	The amount of the benefit after the possible deductions have been applied, plus the amount of Personal Income Tax (if applicable). There may be benefits with a net amount equal to zero, either because it is based on a gross amount of zero, or because it is zero after applying the corresponding deductions. In all benefits outside the Social Security System, the net amount will coincide with the gross amount, since there is no available data on possible deductions. Amount in euro cents. The format is NNNNNNN	MonetaryAmountType	[0..1]
NumberPaymentsYear	It refers to the number of payments corresponding to that	udt:NumericType	[0..1]

Field	Description	Data Type	Cardinality
	benefit in the period of one year. Unless there is an error, this field will always be returned within the benefits of the Registry of Public Social Benefits.		
PeriodOfTime	▸ Effect date: It corresponds to the date of economic effects of the benefit. It will be returned in all cases, except for Temporary Disability benefits (I6 or I7), either the provision in Direct Payment or Delegated Payment. The format is YYYYMMDD ▸ ExpectedEndDate: Corresponds to the date on which the benefit ends. No data will be returned for the benefits of the Registry of Public Social Benefits. In the case of maternity or paternity, it will correspond to the expiration date of the subsidy. In the case of temporary disability, the end date is the date of the last payment made or the last confirmation part noted. In temporary disability, the delegated payment will not be completed.	PeriodOfTimeType	[0..1]
PeriodOfTime	Period of time		
StartDate	Effective start date of a period time. The format is YYYY-MM-DD	udt:DateType	[0..1]
EndDate	Expected end date or effective end date in case of suspension/cancellation/finish. The format is YYYY-MM-DD	udt:DateType	[0..1]
MonetaryAmount	A monetary value.		
currency	The currency in which the Monetary Amount is expressed.	Currency [Table 1]	[0..*]
amount	The quantitative value of the Monetary Amount.	udt:NumericType	[1..1]
Person	An individual natural person who may be dead or alive, but not imaginary.		

Field	Description	Data Type	Cardinality
Identifier	The identifier relation is used to link a Person to any formally issued Identifier for that Person.	cva:CvidentifierType	[0..*]
SocialSecurityNumber	Social Security numbers of the consulted citizen. Up to 10 numbers can be returned, although citizens usually have only one Social Security number, but there are also cases with multiple social security numbers.	cva:CvidentifierType	[1..*]
PersonName	The family name and given name of a Person. At least one of the two must exist.	NameType	[1..1]
DateOfBirth	The day on which the Person was born.	DateObjectType	[1..1]
DateObject	Structured representation of date with year, month and day of the month.		
Year	A Gregorian calendar year. The value space of Year is the set of Gregorian calendar years as defined in § 5.2.1 of ISO 8601. Specifically, it is a set of one-year long, non-periodic instances e.g., lexical 1999 to represent the whole year 1999, independent of how many months and days this year has.	xsd:gYear	[0..1]
Month	A Gregorian month that recurs every year. The value space of Month is the space of a set of calendar months as defined in § 3 of ISO 8601. Specifically, it is a set of one-month long, yearly periodic instances.	xsd:gMonth	[0..1]
Day	A Gregorian day that recurs, specifically a day of the month such as the 5th of the month. The value space of Day is the space of a set of calendar dates as defined in § 3 of ISO 8601. Specifically, it is a set of one-day long, monthly periodic instances.	xsd:gDay	[0..1]
Name	A name of a person that includes the family and given name.		
FamilyName	A family name is usually shared by members of a family. This	cbc:FamilyNameType	[0..*]

Field	Description	Data Type	Cardinality
	attribute also carries prefixes or suffixes which are part of the family name, e.g., "de Boer", "van de Putte", "von und zu Orlow". Multiple family names, such as are commonly found in Hispanic countries, are recorded in the single family name field so that, for example, Miguel de Cervantes Saavedra's Family Name would be recorded as "de Cervantes Saavedra".		
GivenName	A given name, or multiple given names, are the denominator(s) that identify an individual within a family. These are given to a Person by his or her parents at birth or may be legally recognised as 'given names' through a formal process. All given names are ordered in one field so that, for example, the given name for Johann Sebastian Bach is 'Johann Sebastian'.	cvb:GivenNameType	[0..*]

2.3.3.4.2 Unemployment Means of Living Evidence

The Unemployment Means of Living Evidence holds information on unemployment benefits. The model of this type of evidence is analysed in Table 10 below where classes and properties are presented with their data types and cardinalities.

Table 10: Unemployment Means of Living Evidence-attributes specifications

Field	Description	Data Type	Cardinality
UnemploymentMeans OfLivingEvidence			
Identifier	An unambiguous reference to the Unemployment Means of Living Evidence	cva:CvidentifierType	[0..1]
IssueDate	The most recent date on which the Unemployment Means of Living Evidence instance was issued.	udt:DateType	[1..1]
IssuingAuthority	A Public Organisation with official authority in charge of issuing the Unemployment Means of Living Evidence.	PublicOrganisationType	[1..1]
Certifies	Attesting in a formal way that the Unemployment data is true.	UnemplymentMeansOf LivingInfoType	[1..1]

Field	Description	Data Type	Cardinality
PublicOrganisation	Any organisation that is defined as being part of the public sector by a legal framework at any level.		
Identifier	Many organisations are referred to by an acronym or some other identifier. For example, among the EU institutions, the ECB is the identifier for the European Central Bank, OLAF for the European Anti-Fraud Office, and so on. These are formally recognised by the European Commission which provides a list of such acronyms. Analogous lists should be used in other contexts.	cva:CvidentifierType	[0..*]
PrefLabel	As defined in the ORG Ontology, a preferred label is used to provide the primary, legally recognised name of the organisation. An organisation may only have one such name in any given language. Primary names may be provided in multiple languages with multiple instances of the preferred label property.	udt:TextType	[1..*]
UnemploymentMeansOfLivingInfo	Information on unemployment benefits		
DataSubject	The person who is subject to this information	PersonType	[1..1]
UnemploymentData	Current unemployment data of the citizen	UnemploymentDataType	[0..1]
UnemploymentData	One of the two Persons who are jointly the cause of the Child's Birth, i.e. natural parent.		
Status	Status of the benefit. The possible values are: ‣ ACTIVE: the citizen is receiving the unemployment benefit ‣ NON-ACTIVE: the citizen is not receiving the unemployment benefit ‣ NON-ACTIVEdue to APRE (APRE: "Cumulative and early payment of contributory unemployment benefit to foreign workers returning to their country of origin") ‣ NON-ACTIVE when the benefit has been capitalised	StatusTypeEnum	[0..1]
PeriodOfTime	Date of start of the current entitlement situation and date of end.	PeriodOfTimeType	[0..1]

Field	Description	Data Type	Cardinality
	Start date: ▸ If the Situation is "ACTIVE", this field indicates the initial date on which the citizen began to receive unemployment benefit. ▸ If the Situation is "NON-ACTIVE", this field indicates the initial date on which the citizen stopped receiving unemployment benefit. End date: ▸ If the Situation is "ACTIVE", this field represents the granted period of entitlement; it indicates the end date. ▸ If the Situation is "NON-ACTIVE", this field is empty.		
PeriodOfTime	**Period of time**		
StartDate	Effective start date of a period time. The format is YYYY-MM-DD	udt:DateType	[0..1]
EndDate	Expected end date or effective end date in case of suspension/cancellation/finish. The format is YYYY-MM-DD	udt:DateType	[0..1]
Person	**An individual natural person who may be dead or alive, but not imaginary.**		
Identifier	The identifier relation is used to link a Person to any formally issued Identifier for that Person.	cva:CvidentifierType	[0..*]
SocialSecurityNumber	Social Security numbers of the consulted citizen. Up to 10 numbers can be returned, although citizens usually have only one Social Security number, but there are also cases with multiple social security numbers.	cva:CvidentifierType	[1..*]
PersonName	The family name and given name of a Person. At least one of the two must exist.	NameType	[1..1]
DateOfBirth	The day on which the Person was born.	DateObjectType	[1..1]
DateObject	**Structured representation of date with year, month and day of the month.**		
Year	A Gregorian calendar year. The value space of Year is the set of Gregorian calendar years as defined in § 5.2.1 of ISO 8601. Specifically, it is a set of one-year long, non-periodic instances e.g. lexical 1999 to represent the whole year 1999, independent of how many months and days this year has.	xsd:gYear	[0..1]

Field	Description	Data Type	Cardinality
Month	A Gregorian month that recurs every year. The value space of Month is the space of a set of calendar months as defined in § 3 of ISO 8601. Specifically, it is a set of one-month long, yearly periodic instances.	xsd:gMonth	[0..1]
Day	A Gregorian day that recurs, specifically a day of the month such as the 5th of the month. The value space of Day is the space of a set of calendar dates as defined in § 3 of ISO 8601. Specifically, it is a set of one-day long, monthly periodic instances.	xsd:gDay	[0..1]
Name	A name of a person that includes the family and given name.		
FamilyName	A family name is usually shared by members of a family. This attribute also carries prefixes or suffixes which are part of the family name, e.g., "de Boer", "van de Putte", "von und zu Orlow". Multiple family names, such as are commonly found in Hispanic countries, are recorded in the single family name field so that, for example, Miguel de Cervantes Saavedra's Family Name would be recorded as "de Cervantes Saavedra".	cbc:FamilyNameType	[0..*]
GivenName	A given name, or multiple given names, are the denominator(s) that identify an individual within a family. These are given to a Person by his or her parents at birth or may be legally recognised as 'given names' through a formal process. All given names are ordered in one field so that, for example, the given name for Johann Sebastian Bach is 'Johann Sebastian'.	cvb:GivenNameType	[0..*]

2.3.3.4.3 Working Life Means of Living Evidence

The Working Life Means of Living Evidence holds information on the working life benefits. The model of this type of evidence is analysed in Table 11 below where classes and properties are presented with their data types and cardinalities.

Table 11: Working Life Means of Living Evidence-attributes specifications

Field	Description	Data Type	Cardinality
WorkingLifeMeansOfLivingEvidence			
Identifier	An unambiguous reference to the Working Life Means of Living Evidence	cva:CvidentifierType	[0..1]

Field	Description	Data Type	Cardinality
IssueDate	The most recent date on which the Working Life Means of Living Evidence instance was issued.	udt:DateType	[1..1]
IssuingAuthority	A Public Organisation with official authority in charge of issuing the Working Life Means of Living Evidence.	PublicOrganisation Type	[1..1]
Certifies	Attesting in a formal way that the Working Life data is true.	WorkingLifeMeans OfLivingInfoType	[1..1]
PublicOrganisation	Any organisation that is defined as being part of the public sector by a legal framework at any level.		
Identifier	Many organisations are referred to by an acronym or some other identifier. For example, among the EU institutions, the ECB is the identifier for the European Central Bank, OLAF for the European Anti-Fraud Office, and so on. These are formally recognised by the European Commission which provides a list of such acronyms. Analogous lists should be used in other contexts.	cva:CvidentifierTyp e	[0..*]
PrefLabel	As defined in the ORG Ontology, a preferred label is used to provide the primary, legally recognised name of the organisation. An organisation may only have one such name in any given language. Primary names may be provided in multiple languages with multiple instances of the preferred label property.	udt:TextType	[1..*]
WorkingLifeMeansOfLi vingInfo	Information on different working life benefits		
DataSubject	The person who is subject to this information	PersonType	[1..1]
WorkingLife	Working life of the citizen	WorkingLifeType	[0..1]
WorkingLife	Working life of the citizen		
SituationsList	Contains the list of situations of the consulted citizen.	SituationsListType	[0..1]
SituationsList	Contains the list of situations of the consulted citizen.		
Situation	Contains the data of each situation of the consulted citizen.	SituationType	[1..*]
Situation	Contains the data of each situation of the consulted citizen.		

Field	Description	Data Type	Cardinality
SocialSecurityNumber	Social security number of the situation returned.	cva:IdentifierType	[1..1]
Status	Status of the benefit. The possible values are: ▸ ACTIVE: the citizen is receiving the unemployment benefit ▸ NON-ACTIVE: the citizen is not receiving the unemployment benefit ▸ NON-ACTIVE due to APRE (APRE: "Cumulative and early payment of contributory unemployment benefit to foreign workers returning to their country of origin") ▸ NON-ACTIVE when the benefit has been capitalised	StatusTypeEnum	[1..1]
PeriodOfTime	Period of work activity. It includes: ▸ Date of start of work activity. ▸ Date from which the registration takes effect for the purposes of entitlement to the benefits of the Social Security system, except for benefits resulting from accidents at work and occupational diseases, unemployment and health care resulting from common illness, maternity and non-occupational accidents, in which case the effective date of registration coincides, in any case, with the date of employment. ▸ Date of termination of employment.	PeriodOfTimeType	[1..1]
ContractType	Identifier of the employment contract. The list of contract types is available in tab "Contract types".	ContractTypeEnum	[1..1]
PeriodOfTime	Period of time		
StartDate	Effective start date of a period time. The format is YYYY-MM-DD	udt:DateType	[0..1]
EndDate	Expected end date or effective end date in case of suspension/cancellation/finish. The format is YYYY-MM-DD	udt:DateType	[0..1]
Person	An individual natural person who may be dead or alive, but not imaginary.		
Identifier	The identifier relation is used to link a Person to any formally issued Identifier for that Person.	cva:CvidentifierType	[0..*]
SocialSecurityNumber	Social Security numbers of the consulted citizen. Up to 10 numbers can be returned, although citizens usually have only one	cva:CvidentifierType	[1..*]

Field	Description	Data Type	Cardinality
	Social Security number, but there are also cases with multiple social security numbers.		
PersonName	The family name and given name of a Person. At least one of the two must exist.	NameType	[1..1]
DateOfBirth	The day on which the Person was born.	DateObjectType	[1..1]
DateObject	Structured representation of date with year, month and day of the month.		
Year	A Gregorian calendar year. The value space of Year is the set of Gregorian calendar years as defined in § 5.2.1 of ISO 8601. Specifically, it is a set of one-year long, non-periodic instances e.g., lexical 1999 to represent the whole year 1999, independent of how many months and days this year has.	xsd:gYear	[0..1]
Month	A Gregorian month that recurs every year. The value space of Month is the space of a set of calendar months as defined in § 3 of ISO 8601. Specifically, it is a set of one-month long, yearly periodic instances.	xsd:gMonth	[0..1]
Day	A Gregorian day that recurs, specifically a day of the month such as the 5th of the month. The value space of Day is the space of a set of calendar dates as defined in § 3 of ISO 8601. Specifically, it is a set of one-day long, monthly periodic instances.	xsd:gDay	[0..1]
Name	A name of a person that includes the family and given name.		
FamilyName	A family name is usually shared by members of a family. This attribute also carries prefixes or suffixes which are part of the family name, e.g., "de Boer", "van de Putte", "von und zu Orlow". Multiple family names, such as are commonly found in Hispanic countries, are recorded in the single family name field so that, for example, Miguel de Cervantes Saavedra's Family Name would be recorded as "de Cervantes Saavedra".	cbc:FamilyNameType	[0..*]
GivenName	A given name, or multiple given names, are the denominator(s) that identify an individual within a family. These are given to a Person by his or her parents at birth or may be legally recognised as 'given names' through a formal process. All given names	cvb:GivenNameType	[0..*]

Field	Description	Data Type	Cardinality
	are ordered in one field so that, for example, the given name for Johann Sebastian Bach is 'Johann Sebastian'.		

2.3.3.5   Domicile Deregistration Evidence

The domicile deregistration evidence intends to send back the information of the new address of a person who is already registered in a new domicile to the country of his/her previous domicile. In other words, once the person is registered in his/her new domicile, the country of the previous (old) domicile gets to be notified of the new address. However, at the time of writing this deliverable (February 2022) the Moving abroad pilot and WP3 has not reached to a conclusion of which type of information should be contained in this canonical evidence. As reported in D3.4"*Semantic framework- Final version"*, one option is to reuse the Domicile registration evidence (as described earlier in this subsection). In contrast, selecting a subset of the attributes of Domicile registration evidence, following the SDG recommendation of data minimisation, is also under consideration. The latest version of this canonical evidence will be updated in the DE4A wiki [26], and the GitHub repository of WP3 implementations [21] .

3 Information Desk Specification

The scope and requirements underlying the Information Desk (IDK) were presented in the previous deliverables D3.2 *"Final Requirements for Semantic Assets"* and D3.4 *"Semantic Framework- Final version"*. The overall goal of the Information Desk is to provide the required information to enable the exchange between cross-border competent authorities for the retrieving of evidences and the subscription to event catalogues. It is composed of four components:

▸ Issuing Authority Locator (IAL)
▸ Evidence Service Locator (ESL)
▸ Multilingual Ontology Repository (MOR)
▸ Cross-border Access Authorization Registry (CAAR)

The actual implementation of the IAL and ESL components is undertaken by DE4A WP5, as part of the eDelivery SMP and the Business Card extension. While the ESL specification is based on the eDelivery SMP specification, this chapter presents the key aspects of the IAL OpenAPI specification. On the other hand, The MOOR functionality is implemented for the Moving Abroad Pilot, but the CAAR component is not implemented by the project although its requirements and design have been developed in the previous deliverables D3.2 *"Final Requirements for Semantic Assets"* and D3.4 *"Semantic Framework- Final version"*.

3.1 IAL OpenAPI specification

The Issuing Authority Locator (IAL) is required to provide the list of available provisions under different types of consultations available by a REST API with several paths.

Some changes have been introduced to cover the 2nd iteration requirements, such as subscription provisions and the dynamic exchange for redirecting URLs to implement the User-Supported Intermediation (USI) Pattern. Currently, IAL contains both evidence provisions and subscription provisions regarding canonical evidence types and event catalogues respectively.

The IAL API is specified according to the OpenAPI [28]standard to provide a language-agnostic interface to RESTful APIs. The IAL API is available at the respective repository of the project's GitHub space [21].

3.1.1 IAL API Paths

IAL can be queried in different ways:

▸ *By Canonical Evidence Type, at least one type*, to get all the evidence provisions available in the system for (a) specific canonical evidence type(s). This consultation may help to show the user only the countries with issuing authorities that provide certain canonical evidence type(s) through the system; for other countries users only could provide the required evidence by their own means.

Table 12: Evidence provisions by canonical evidence type

Path	/ial/{canonicalEvidenceTypeIds}
Method[1]	GET
Description	List of available provisions of the given canonical evidence type(s), grouped by country and administrative level of the issuers. If there are many provisions, the response is their number per country and administrative territorial level.

---

[1] RESTful API HTTP methods: https://restfulapi.net/http-methods/

Path	/ial/{canonicalEvidenceTypeIds}
Parameters	**canonicalEvidenceTypeIds**: Token name and version of a canonical evidence type, or a list of them separated by commas. Required. Examples: "**BirthEvidence:1.0**", or **BirthEvidence:1.0,MarriageEvidence:1.0**"
Response	{AvailableSources}

▸ *By Administrative Territorial Unit (ATU) and at least one Canonical Evidence Type*, to get all the evidence provisions available in the system for (a) specific canonical evidence type(s) and provided by issuing authorities at a specific territorial unit, usually a country. This consultation may help when the list of available provisions was quite large and the user was requested to specify an administrative territorial unit, such a municipality, so the consultation can ask for provisions by competent authorities at that territorial unit.

Table 13: Evidence provisions by canonical evidence type and territorial unit

Path	/ial/{atuCode}/{canonicalEvidenceTypeIds}
Method	GET
Description	List of available provisions, grouped by country and administrative level of the issuers, of the given canonical evidence type(s) and issuing authorities at the given administrative territorial unit.
Parameters	**canonicalEvidenceTypeIds**: Token name of a canonical evidence type and version, or a list of them separated by commas. Required. Examples: "**BirthEvidence:1.0**", or "**BirthEvidence:1.0,MarriageEvidence:1.0**". **atuCode**: Code of the territorial unit, either a country (NUTS0), a region (NUTS1-2-3), a municipality (LAU)), or an educational competent authority (EDU) [Table 1]. Required. Examples: "**NL**", or "**ES28079**".
Response	{AvailableSources}

▸ *By Canonical Event Catalogue and issuing Country*, to get all the subscription provisions available in the system for a canonical event catalogue and provided by issuing authorities at a country.

Table 14: Subscription provisions by canonical event catalogue and country

Path	/subscription/{canonicalEventCatalogId}/{countryCode}
Method	GET
Description	List of available provisions for subscribing in the given country to events of the given canonical event catalogue.
Parameters	**canonicalEventCatalogId**: canonical event catalogue id. Required. Example: "**BusinessEvents**". **countryCode**: NUTS0 of the provision authority. Required . [Table 1]. Example: "**SE**".
Response	{atuLevel, [ProvisionItem]}

▸ *By Canonical Event Catalogue*, to get all the available subscription provisions in the system for a canonical event catalogue.

Table 15: Subscription provisions by canonical event catalogue

Path	/subscription/{canonicalEventCatalogId}
Method	GET

Path	/subscription/{canonicalEventCatalogId}
Description	List of available provisions, grouped by country, for subscribing to events of the given canonical event catalogue.
Parameters	**canonicalEventCatalogId:** Canonical event catalogue ID. Required. Example: "**BusinessEvents**".
Response	{AvailableSources}

▸ *By category of object type (evidence or event), by object type (a canonical evidence type or an event catalogue) and issuing authority*, to get event or subscription provisions available in the system of a given type and a given data owner.

Table 16: IAL provision by category of provided object type, object type and data owner

Path	/provision/{provisionType}/{provisionObjectType}?dataOwnerId={}
Method	GET
Description	Returns the specific characteristic of the provision given its provider (data owner) and either a canonical evidence type or a canonical event catalogue.
Parameters	**provisionType**: Type of the provision. Required. Possible values: "**evidence**", or "**event**". **provisionObjectType**: ID of evidence or event type with a canonical definition. Required. Examples: "**BirthEvidence:1.0**", or "**BusinessEvents**". **dataOwnerId**: Data owner of the provision. Required. Example: "**iso6523-actorid-upis::9991:LU000000025**".
Response	{atuLevel, [ProvisionItem]}

3.1.2   IAL API Response Objects

▸ The object **AvailableSources** is an array of provisions available in the system, grouped by country and administrative territorial level, so each entry of the array is composed of three attributes:

- *countryCode*: country code of the available provisions according to the NUTS0 code list, e.g. ES (Spain)
- *atuLevel*: object of type {AtuLevel} representing the administrative territorial level of the available provisions
- *provisions*: either the list available provisions or the number of them when the list is large (e.g. 8123 municipalities):
  • In the first case, the list is an array of {*ProvisionItem*}
  • In second case, it is an object composed of two attributes:
    ▪ *numProvisions*: number of available provisions at the *atuLevel*
    ▪ *organisation*: path of the upper-level administrative territorial unit of the issuing authorities of the provisions. For instance, if such authorities are the 8.123 Spanish municipalities (*countryCode=ES, atuLevel=lau, numProvisions=8123*), the organisation path would be "ES/nuts2/nuts3" for the DE to ask the user to select the territorial unit at the *nuts2* level in Spain, i.e. one of the 19 autonomous communities, and then the territorial unit at the *nuts3* level in Spain, i.e. one of the provinces of the selected autonomous community, and then the territorial unit at *lau* level (municipality) within the selected province.

▶ The object ***atuLevel*** represents the administrative territorial level of issuing authorities according to the territorial scope of their administrative competences. Possible values are:

- *nuts0*, for competences at the whole country
- *nuts1*, for competences at some territorial unit corresponding to the 1st level of the NUTS classification
- *nuts2*, for competences at some territorial unit corresponding to the 2nd level of the NUTS classification
- *nuts3*, for competences at some territorial unit corresponding to the 3rd level of the NUTS classification
- *lau*, for competences at some local territorial unit included in the LAU code list
- *edu*, for competences at some territorial unit corresponding to an educational institution, such as a university, with own administrative competences.

▶ The object *ProvisionItem* represents an available provision for which an associated ESL service exists:

- *atuCode*: code of the administrative territorial unit of the issuing authority, according to the NUTS/LAU/EDU code lists (e.g. ES10).
- *atuLatinName*: name of the administrative territorial unit of the issuing authority.
- *dataOwnerId*: URN of the issuing authority according to the DE4A identifiers policy.
- *dataOwnerPrefLabel*: name of the issuing authority
- *details*: either an array of subscription provisions or an array of evidence provisions:
  - In the first case, each subscription provision is represented by the identification token of the canonical event catalogue, according to the DE4A identifiers policy (e.g. BusinessEvents).
  - In the second case, each evidence provision is represented by the next attributes:
    - *canonicalEvidenceType*: token name and version of the canonical evidence type, according to the DE4A identifiers policy (e.g. BirthEvidence:1.0)
    - *parametersets*: optionally, the list of alternative set of parameters to be provided by the users. Each set of parameters is an array whose items are URI paths of the MOR terms that represent the semantics of each parameter.

3.2   ESL connection to IAL

As explained above, ESL is implemented as part of the eDelivery SMP. According to the SMP specification, four values are required to locate the metadata of a service, but only two of them have not fixed value in the DE4A implementation: participant ID and document ID. The provision resulting of the IAL consultation provides these two entries:

▶ *Participant ID*: URI that identifies the addressee of the message, *dataOwnerId*, according to the DE4A Policy for Identifiers

▶ *Document ID*: URN, according to the DE4A Policy for Identifiers, either of the canonical event catalogue for subscription requests, or the canonical evidence type for evidence exchange requests

3.3   MOR implementation

MOR implementation has two aspects: the storage of the MOR terms according to a specification, and the common GUI components to provide, in a multilingual way, a customizable user interface for the explicit request, evidence preview and requesting additional parameters for the record matching. For the 2nd iteration of the project, GUI for requesting additional parameters has not been considered, and some simplifications have been adopted for the implementation of the MOR storage to reduce the technical complexity of its implementation. MOR implementation is aimed to be used by the Moving

Abroad pilot, so only *BirthEvidence* and *MarriageEvidence* canonical evidence types have been considered.

At the time of this deliverable (February 2022), the MOR implementation is ongoing, so further changes are possible on the details included in this section as the MOR implementation is completed and tested.

3.3.1 Simplified MOR storage

The storage of MOR terms is implemented as JSON files, one per available language. Microsoft Excel has been used to ease the creation of JSON files. Each MOR Excel file is aimed to specify each MOR complex term that represents canonical evidence types, complex terms used as types of other complex terms, like Person or Location, or code lists such as the Member States, administrative-territorial units or languages code lists.

A MOR Excel file has a sheet "Term" to list all the terms that hierarchically compose the MOR complex type being specified and according to its corresponding XML Schema. A MOR Excel file also contains a sheet per available language with the labels, descriptions, and examples for each entry in the sheet "Term" in that language. Available languages are the ones related to the Member States that participate in the Moving Abroad pilot: French (fr), Portuguese (pt), Slovenian (sl), Spanish (es), and, as the common language, English (en).

Each row of the sheet "Term" specifies by five columns a MOR term that is part of the MOR complex term -canonical evidence type, complex terms used as complex types and code lists- that is specified by the Excel file:

1. *Term URI*: URI as the path corresponding to the XML element of the term in the XML schema of the complex term being specified by the MOR Excel file. For instance, the root MOR term of the *BirthEvidence:1.0* canonical evidence type would be "*BirthEvidence*", i.e. the root element of the corresponding XML schema; the rest of the sub-elements of such XML schema are also specified as MOR terms, such as "*BirthEvidence/CertifiesBirth/Child*".

2. *Origin*: source of the type of term, either DE4A or other XML namespaces, such as the ones used by ISA2. Now this field is not part of the JSON file that implements the MOR storage.

3. *Type*: depending on the nature of the term, there are different alternatives

    a. XML base type with prefix "xsd:" (e.g.: xsd:string) for a simple term

    b. "xsd:enumeration" for a complex term defined as a code list

    c. "xsd:token" for a simple term defined as an entry of a code list

    d. No type for root MOR terms, i.e., a complex term whose sub-elements are included in the same sheet, so their URI starts with the URI of the complex term (e.g., BirthEvidence)

    e. The URI of another MOR term that is specified in a different Excel file (e.g. the MOR term *LocationAddress* as a type of the MOR term *BirthEvidence/CertifiesBirth/Child/ PlaceOfBirth*).

    In this case, no additional values for other properties or sub-elements are required since the whole specification of the term referred to as a type is assumed. However, if some property of the term has a value, this is used instead of the corresponding value of the term referred to as a type (e.g. LocationAddress has no cardinality and English label "Location" while BirthEvidence/CertifiesBirth/Child/PlaceOfBirth has 10 cardinality and English label "Country and place of birth"). Additional sub-elements of the term can be included in the same Excel file to extend the number of sub-elements of the term referred to as a type. If the term has fewer sub-elements than the term

referred to as a type, all the sub-elements should be included in the Excel file following the term.

4. *Cardinality*: two binary digits representing Boolean values (true=1, false=0). The first digit represents if the term is mandatory; the second digit represents if the term can have multiple values. Root MOR terms -representing canonical evidence types and reusable complex types such as *Location* or *Person* and code lists such as *Country*- have no cardinality.

5. *Comments*: optional text to clarify the term specification.

Each language sheet is named as the two-letter code of the language, and has the same first column as the sheet "Term" followed by four columns to specify the term according to such a language and the context of the complex type that is specified by the Excel file:

2. *Label*: a short label for the term, which cannot be empty if the term type is not the URI to another MOR term

3. *Description*: optional description of the term

4. *Example*: a possible value of a simple term coherent with the language and the context. Complex terms cannot have examples. This value is not mandatory.

5. *Verified*: boolean value that is true if an expert on the context verifies the correctness of the previous columns.

3.3.2 MOR API

The storage of MOR is implemented as JSON files, one per available language, so the WP5 Connector is providing one of these JSON files through a REST API.

An Excel Macro file has been provided to generate the JSON files to be provided by the Connector. The macro uses a list with the paths to Excel files with the MOR complex type specifications to be included in the generated JSON files, as well as a list with the languages to consider. These two lists are included in the same sheet of the button to execute the macro.

The MOR API is defined to be the same for future implementation of the MOR storage with an actual database system. The MOR API of the Connector has one path to retrieve all MOR terms in a given language: *"/mor/{lang}"*

The JSON structure be returned by the MOR API contains:

▸ a generic object of type "*MORtype*" whose name is a MOR term URI path (e.g. "BirthEvidence", "BirthEvidence/Child" etc.).
▸ The "MORtype" object is composed by any number of objects of type "TermType".
▸ The "TermType" object has four properties:
  - "type", corresponding to the same column of the MOR Excel sheet "Term", with the same constraints.
  - "cardinality", corresponding to the same column of the MOR Excel sheet "Term", with the same constraints.
  - "comment", corresponding to the same column of the MOR Excel sheet "Term", with the same constraints.
  - object of type "LangType", whose name is the two-letter code of the given language.
▸ The "LangType" object has four properties corresponding to the same columns of the MOR Excel sheets with the language specification, so their constraints also apply to these properties:
  - "label"
  - "description"
  - "example"
  - "verified"

Examples of "TermType" objects when English is the selected language:

▸ For the English specification of the Canonical Evidence Type "BirthEvidence", so "type" and "cardinality" are empty because it is a root MOR term:

```
"BirthEvidence" : {
        "type" : "",
        "cardinality" : "",
        "comment" : ""
        , "en" : {
                "label" : "Birth evidence",
                "description" : "Information from an official registry proving the Birth of a Child.",
                "example" : "",
                "verified" : "true"
        }
}
```

▸ For the English specification of the element "/BirthEvidence/CertifiesBirth/Child/PlaceOfBirth" of the XML representation of the Canonical Evidence Type "BirthEvidence", whose type is the MOR term "Person/DateOfBirth" but with a different cardinality and description:

```
"BirthEvidence/CertifiesBirth/Child/PlaceOfBirth" : {
        "type" : "Person/DateOfBirth",
        "cardinality" : "10",
        "comment" : ""
        , "en" : {
                "label" : "",
                "description" : " Country and place of birth ",
                "example" : "",
                "verified" : "true"
        }
}
```

Same examples when Spanish is the selected language:

```
"BirthEvidence" : {
        "type" : "",
        "cardinality" : "",
        "comment" : ""
        , "es" : {
                "label" : "Prueba de nacimiento",
                "description" : "Información sobre un nacimiento que prueba su registro.",
                "example" : "",
                "verified" : "true"
        }
}
"BirthEvidence/CertifiesBirth/Child/PlaceOfBirth" : {
        "type" : "Person/DateOfBirth",
        "cardinality" : "10",
        "comment" : ""
        , "es" : {
                "label" : "",
                "description" : "País y lugar de nacimiento",
                "example" : "",
                "verified" : "true"
        }
}
```

The JSON specification of the MOR API response is aimed to ease the finding of MOR terms when using a Javascript JSON variable. Because of this reason, the *MORtype* has not been defined as an Array but an Object, and the name of their properties, defined as *TermType* objects, are the URIs of the different MOR terms. Because of this specification, if the content of a MOR JSON file for a certain language is loaded in the Javascript JSON variable "morJsonVar", the MOR specification of the term with uri="BirthEvidence/CertifiesBirth/Child/PlaceOfBirth" can be easily obtained by the expression morJsonVar[uri]. The reason to use the two-letter codes of languages as the name of the property of "LangType" objects is, on one side, to avoid errors for retrieving specifications in a language different

from the one selected by the user and, on the other side, to allow an alternative implementation of the "TermType" object that includes several "LangType" objects for the different available languages.

3.3.3   MOR common customizable GUI

Explicit request and evidence preview functionalities require every DE and, when using the User-Supported Intermediation Pattern, every DO to provide a user web interface. Because of the cross-border situation of both competent authorities along with the user, who could be a national of a different Member State, language is a sensitive matter.

Because of the agreement on common forms and semantics of canonical evidence types, the MOR multilingual specification of the terms that compose such types, and the customization facilities provided by Cascading Style Sheets (CSS), JavaScript and HTML, a static web development can be provided to support the explicit request and evidence preview functionalities to be easily integrated to DEs and DOs portals.

CSS resources associated with the MOR GUI page can be modified to adapt it to the graphical style of each portal. The exchange of data between the MOR GUI page and the page of the portal is implemented by JavaScript variables.

3.3.3.1   Explicit request

The MOR GUI page for the explicit request is opened by a page of the DE portal. At the opening, it is specified a given default language, the DE country, a list of Canonical Evidence Types identified by its token names, and the name of a JavaScript Map variable at the opening page to fill by the MOR GUI page with the result of the explicit request. For instance:

```
<app-mor-er
  defaultLang = "en"
  requesterCountryCode = "BE"
  canonicalEvidenceTypes = "BirthEvidence,MarriageCertificate"
  outputJSMapId = "outputJSMapIdMorEr"
></app-mor-er>
```

When the MOR GUI page is open, the Connector is requested with the MOR API for the MOR JSON in the given language.

The MOR GUI page shows, in the given language and per canonical Evidence type, the name of the evidence type, a list to select the issuing country -except the requesting country-, and a choice to select the use of the system to get the evidence or to manually upload the evidence in some electronic format (e.g. XML, PDF or any image format). Figure 8 shows a basic form for this MOR GUI page.
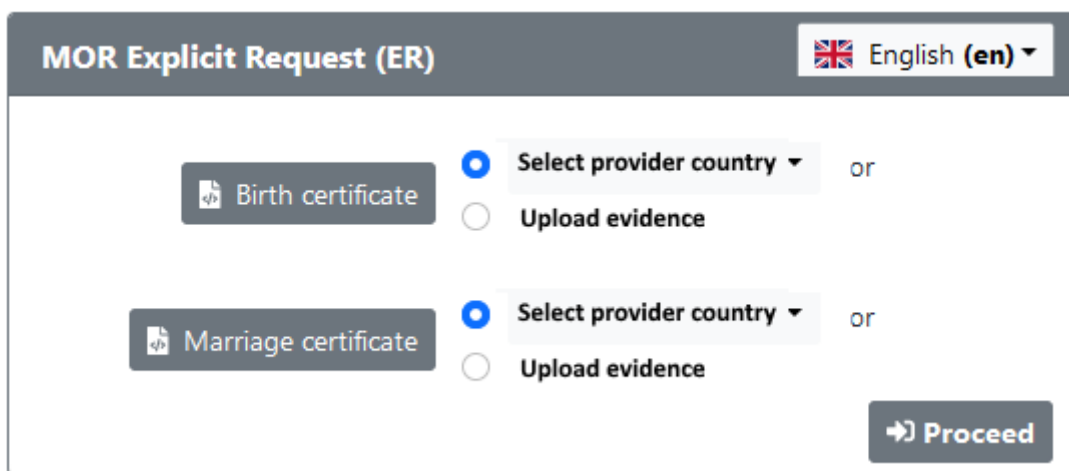

Figure 8: MOR GUI for explicit request

By clicking on the name of a canonical evidence type, the description of its common form is presented to the user in the given language as specified in the MOR JSON.

If the user changes the language of the MOR GUI page and confirms the action, it is repainted after retrieving from the Connector the MOR JSON according to the new language.

The selection made by the user per canonical evidence type is returned by filling the Map variable specified by the opening page. The Token name for the canonical evidence type is the key of each Map entry with two possible values depending on the user choice: the selected provider country or the ASCII representation of the uploaded file, which can be either an ASCII file such as a XML file or a binary file such as a PDF.

3.3.3.2   Evidence Preview

After the issuing the requested canonical evidences, the MOR GUI page for the evidence preview is opened by a web page at the DE or DO side, depending on the type of exchange pattern, Intermediation (IM) or User Supported Intermediation (USI) respectively.
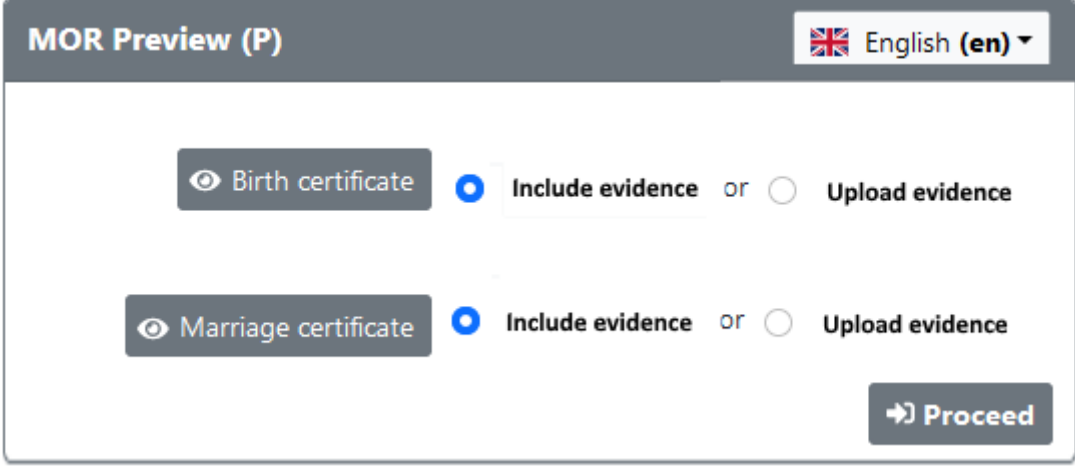
At the opening, it is specified a language, a JSON array with objects of two attributes, token name of a canonical evidence type and the XML of the issued canonical evidence to preview, and the name of a JavaScript Map variable at the opening page to fill by the MOR GUI page with the result of the evidence preview. For instance:

```
<app-mor-p
  defaultLang = "en"
  postActionValue = "[{…}, {…}]"
  outputJSMapId = "outputJSMapIdMorEr"
></app-mor-p>
```

The MOR GUI page shows, in the given language and per canonical Evidence type, the name of the canonical evidence type and a choice to include the issued canonical evidence, or to manually upload the evidence in some electronic format (e.g. XML, PDF or any image format) to replace the canonical evidence. Users should provide the required evidence when they refuse to use the issued canonical evidence if they want their procedure application to be processed. Figure 9 shows a basic form for this MOR GUI page.

By clicking on the name of the canonical evidence type, the corresponding issued canonical evidence is shown in a human-readable way with the labels and descriptions of its elements and code lists in the selected language, as specified in the MOR JSON file.

Figure 9: MOR GUI for evidence preview

If the user changes the language of the MOR GUI page and confirms the action, it is repainted after retrieving from the Connector the MOR JSON according to the new language.

The selection made by the user per canonical evidence type is returned by filling the Map variable specified by the opening page. The Token name for a canonical evidence type is the key of the Map entry with two possible values depending on the user choice: "true" if the canonical evidence has to be included or the ASCII representation of the uploaded file, which can be either an ASCII file such as a XML file or a binary file such as a PDF.

4 Information Exchange Model Implementation

The DE4A Information Exchange Model (IEM) is the payload specification for the messages to be exchanged between competent authorities and is agnostic to any technical implementation. The scope, requirements and design underlying IEM were presented in D3.2 *"Final Requirements for Semantic Assets"* and D3.4 *"Semantic Framework- Final version"*, and this chapter presents the implementation of the model as an XML schema, whose figures are provided by the Design View of the Eclipse IDE for Enterprise Java and Web Developers tool.

As already presented in previous deliverables, there are three types of IEM messages:
1. **IEM Request message**: Sent by a DE to a DO to obtain a response.
2. **IEM Response message**: Sent by a DO to a DE in response to a IEM Request message.
3. **IEM Event Notification message**: Sent by a DO to a DE to notify about an event because of a previous event catalogue subscription.

The following subsections present in detail the implementation of the above message types.

4.1 IEM Request Message

Figure 10 below illustrates the elements that are common to any type of request, followed by Table 17 with respective descriptions and cardinalities. The "choice" element allows to include one or more request items of the three possible types, so IEM Request messages between a DO and a DE can include multiple requests at once.
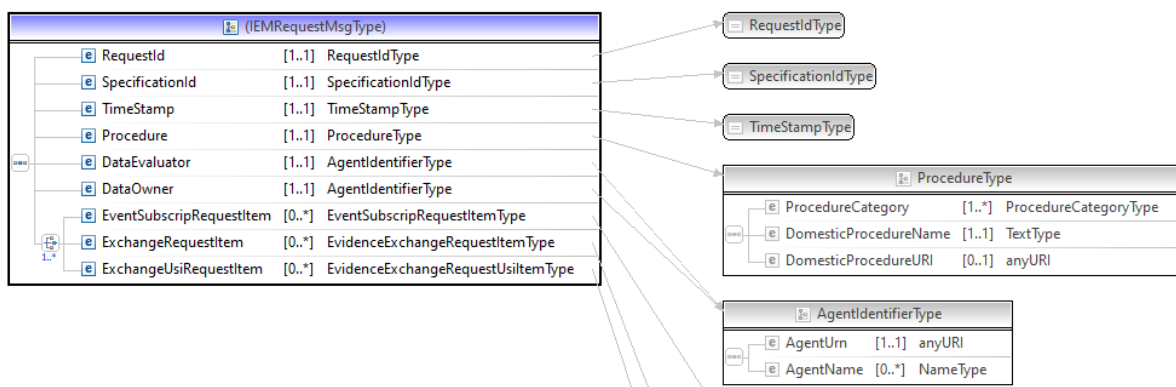

Figure 10: IEMRequestMsgType for Common IEM Request message elements

Table 17: List of common concepts adopted in IEM Request Message

Field	Description	Cardinality
RequestId	Unique identifier of the Request Message (e.g. UUID).	1..1
SpecificationId	Identifier of the IEM Request Message specification.	1..1
TimeStamp	Day and time of the message sending.	1..1
Procedure	Information about the DE's administrative procedure whose processing requires the request. This information includes at least one category for the procedure according to the SDG regulation, the name of the procedure in a specific language and, optionally, its URI.	1..1
DataEvaluator	URN according to the DE4A policy of identifiers and, optionally, the organization name.	1..1

DataOwner	URN according to the DE4A policy of identifiers and, optionally, the organization name.	1..1
EventSubscripRequestItem	Requesting the subscription to a DO's canonical event catalogue regarding a particular data subject.	0..*
ExchangeRequestItem	Requesting a DO's canonical evidence type regarding a particular data subject because of certain grounds.	0..*
ExchangeUsiRequestItem	Requesting a DO's redirection URL for a USI exchange, which includes the DE's URL to redirect back the user.	0..*

4.1.1 EventSubscripRequestItem

Figure 11 below illustrates the elements of the *EventSubscripRequestItemType* that specify the request for the subscription of the DE to a canonical event catalogue provided by the DO regarding the specified data subject. Table 18 shows respective descriptions and cardinalities.
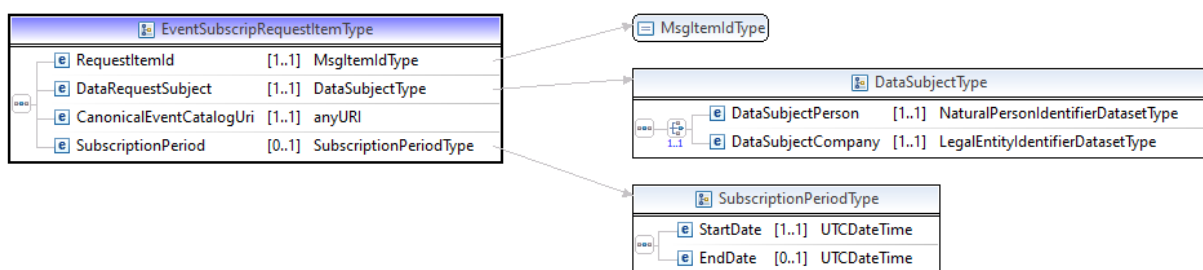
Figure 11: EventSubscripRequestItemType elements

Table 18: List of concepts adopted in EventSubscripRequestItem

Field	Description	Cardinality
RequestItemId	Unique identifier of the request item within the request message (e.g., sequential number).	1..1
DataRequestSubject	Either a natural or a legal person represented by the eIDAS profile attributes (eIDAS datasets).	1..1
CanonicalEventCatalogUri	Unique identifier of a canonical event catalogue according to the DE4A policy of identifiers.	1..1
SubscriptionPeriod	Optionally, the starting date and time and, optionally, the ending date and time of the subscription.	0..1

4.1.2 ExchangeRequestItem

Figure 12 below illustrates the elements of the *EvidenceExchangeRequestItemType* that specify the request made by the DE to the DO for an evidence of the given canonical evidence type regarding the specified data subject. The *EvidenceExchangeRequestItemType* inherits from the *EvidenceExchangeType*. Table 19 shows respective descriptions and cardinalities.

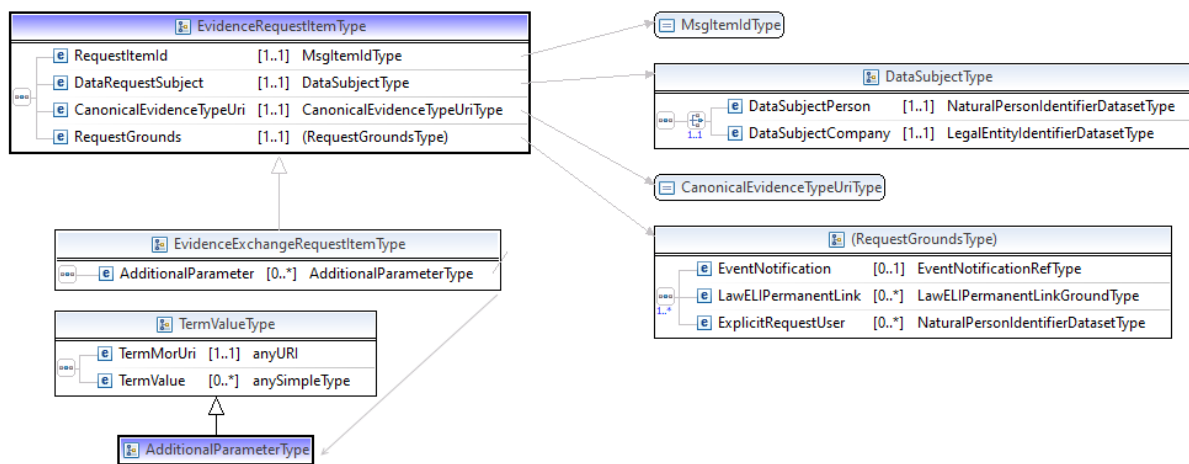Figure 12: ExchangeRequestItemType elements

Table 19: List of concepts adopted in ExchangeRequestItem elements

Field	Description	Cardinality
RequestItemId	Unique identifier of the request item within the request message (e.g., sequential number).	1..1
DataRequestSubject	Either a natural or a legal person represented by the eIDAS profile attributes (eIDAS datasets).	1..1
CanonicalEvidenceType	Unique identifier of a canonical evidence type according to the DE4A policy of identifiers.	1..1
RequestGrounds	Grounds of the request, either an empty *EventNotification* element when the request is motivated by a former event notification, or a *LawELIPermanentLink* element with the link to a law according to the ELI specification, or the *ExplicitRequestUser* element with the eIDAS Dataset for the natural person that explicitly request the use of the system to obtain the evidence.	0..1
AdditionalParameters	Optionally, for Intermediation Pattern evidence provisions, the request may include values for the additional parameters specified in such provisions. AdditionalParameterType inherits from the TermValueType, which identifies the parameter as an URI of a MOR term.	0..*

4.1.3 ExchangeUsiRequestItem

Finally, Figure 13 below illustrates the elements of the *ExchangeUsiRequestItemType* that specify the request made by the DE to the DO for the URL to redirect the user to for obtaining an evidence of the given canonical evidence type regarding the specified data subject; in the request, the DE notifies the URL to redirect the user back to the DE's portal. The *ExchangeUsiRequestItemType* inherits from the *EvidenceExchangeType*. Table 20 shows respective descriptions and cardinalities.
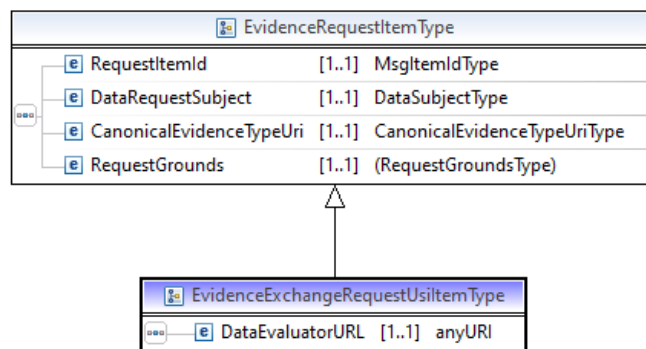
Figure 13: EvidenceExchangeRequestUsiItemType elements

Table 20: List of concepts, their description, and respective cardinalities adopted in ExchangeUSiRequestItem

Field	Description	Cardinality
RequestItemId	Unique identifier of the request item within the request message (e.g., sequential number).	1..1
DataRequestSubject	Either a natural or a legal person represented by the eIDAS profile attributes (eIDAS datasets).	1..1
CanonicalEvidenceTypeUri	Unique identifier of a canonical evidence type according to the DE4A policy of identifiers.	1..1
DataEvaluatorURL	DE's URL to redirect the user back to the DE's portal.	1..1

4.2 IEM Response Message

The figure below illustrates the elements that are common to any type of response, followed by Table 21 with respective descriptions and cardinalities. The "choice" element allows to include any number of response items to respond to any of the three possible request item types that the request message could include, along with a generic error response.
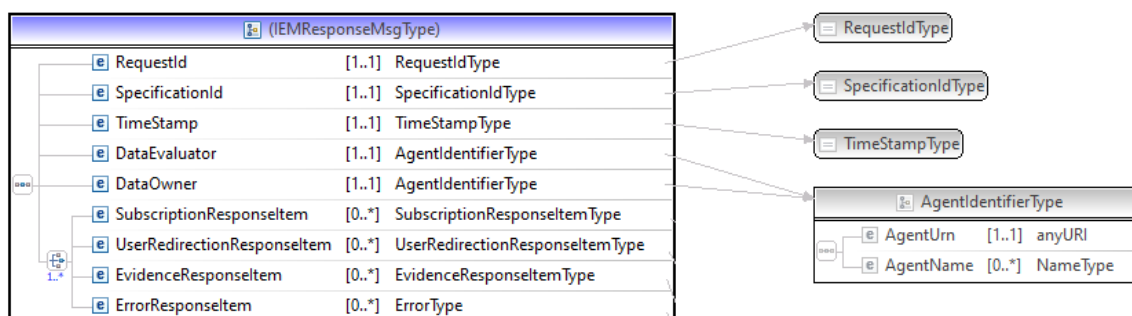

Figure 14: IEMResponseMsgType for Common IEM Response message elements

Table 21: List of common concepts, their description, and respective cardinalities adopted in IEM Response message elements

Field	Description	Cardinality
RequestId	Unique identifier of the Request Message (e.g. UUID) that the Response Message is responding to.	1..1
SpecificationId	Identifier of the IEM Response Message specification.	1..1
TimeStamp	Day and time of the message sending.	1..1
DataEvaluator	URN according to the DE4A policy of identifiers and, optionally, the organization name.	1..1
DataOwner	URN according to the DE4A policy of identifiers and, optionally, the organization name.	1..1
SubscriptionResponseItem	Response to an event catalogue subscription request.	0..1
UserRedirectionResponseItem	Response to a USI redirection URL request.	0..1
EvidenceResponseItem	Response to a canonical evidence type request.	0..1
ErrorResponseItem	Error as response to any request.	0..1

4.2.1   SubscriptionResponseItem

Figure 15 below illustrates the elements of the *SubscriptionResponseItemType* with the response to a subscription request item, followed by the Table 22 with respective descriptions and cardinalities.
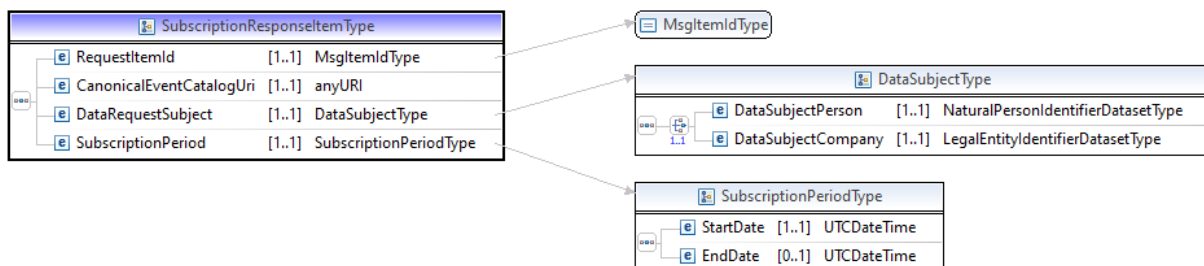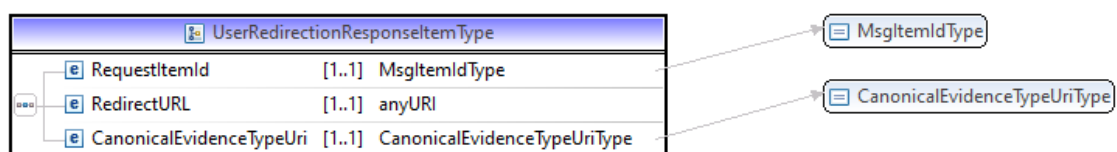

Figure 15: SubscriptionResponseItemType elements

Table 22: List of concepts, their description, and respective cardinalities adopted in SubscriptionResponseItem elements

Field	Description	Cardinality
RequestItemId	Unique identifier of the request item within the corresponding request message that this response item is responding to.	1..1
DataRequestSubject	Either a natural person or a legal person represented by the eIDAS profile attributes (eIDAS datasets). To be used as a safeguard for the matching between request and response items since both items should be related to the same data subject.	1..1
CanonicalEvidenceTypeUri	Unique identifier of a canonical event catalogue according to the DE4A policy of identifiers. To be used as a	1..1

Field	Description	Cardinality
	safeguard for the matching between request and response items since both items should be related to the same canonical evidence type.	
SubscriptionPeriod	The starting date and time and, optionally, the ending date and time of the subscription finally granted.	1..1

4.2.2   UserRedirectionResponseItem

Figure 16 below illustrates the elements of the *UserRedirectionResponseItemType* with the response to a USI redirection URL request item, followed by Table 23 with respective descriptions and cardinalities.

Figure 16: UserRedirectionResponseItemType elements

Table 23: List of concepts, their description, and respective cardinalities adopted in UserRedirectionResponseItem elements

Field	Description	Cardinality
RequestItemId	Unique identifier of the request item within the corresponding request message that this response item is responding to.	1..1
RedirectURL	URL to redirect the user to the DO's portal.	1..1
CanonicalEvidenceTypeUri	Unique identifier of a canonical evidence type according to the DE4A policy of identifiers. To be used as a safeguard for the matching between request and response items since both items should be related to the same canonical evidence type.	1..1

4.2.3   EvidenceResponseItem

Figure 17 illustrates the elements of the *EvidenceResponseItemType* with the response to an evidence request item, followed by Table 24 with respective descriptions and cardinalities.
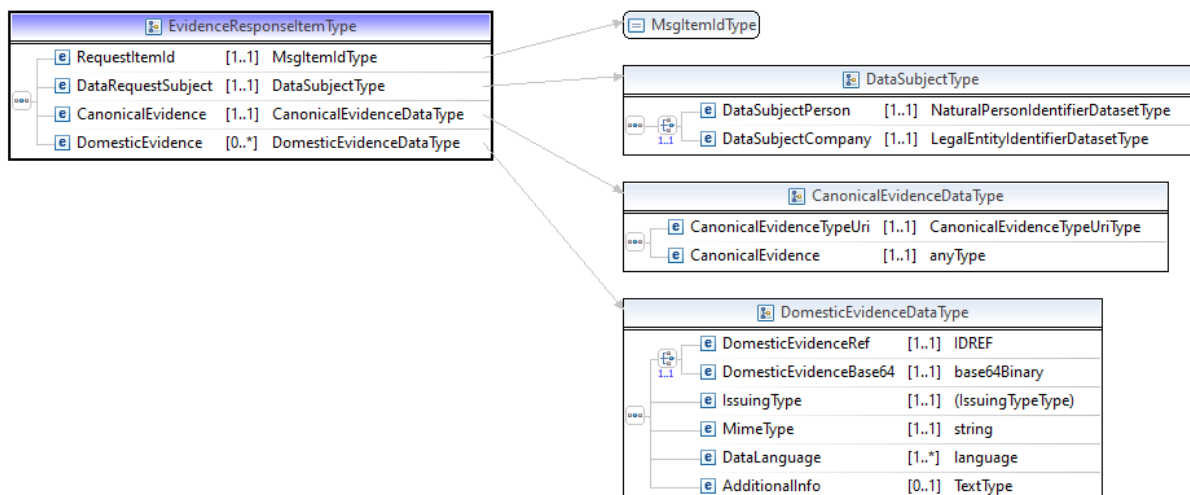
Figure 17: EvidenceResponseItemType elements

Table 24: List of concepts, their description, and respective cardinalities adopted in EvidenceResponseItem elements

Field	Description	Cardinality
RequestItemId	Unique identifier of the request item within the corresponding request message that this response item is responding to.	1..1
DataRequestSubject	Either a natural person or a legal person represented by the eIDAS profile attributes (eIDAS datasets). To be used as a safeguard for the matching between request and response items since both items should be related to the same data subject.	1..1
CanonicalEvidence	The unique identifier of the requested canonical evidence type according to the DE4A policy of identifiers and the canonical evidence issued by the DO according to the request. The canonical evidence type is used as a safeguard for the matching between request and response items since both items should be related to the type.	1..1
DomesticEvidence	Optionally, the domestic evidence corresponding to the required canonical evidence type as originally issued with legal value and, if needed in the case of the Public Document Regulation, the corresponding multilingual standard form. A domestic evidence is represented by the issuing type (original or multilingual form), the mime type of the evidence object, the language of the evidence information (at least one language; multilingual forms have two languages), either a reference to the evidence object in an element outside the IEM payload or the object itself represented in Base 64 encoding, and optionally any additional information considered useful by the DO.	0..*

4.2.4 ErrorResponseItem

Finally, Figure 18 illustrates the elements of the ErrorType with an error response to any evidence request item regarding either an evidence provision or a subscription provision, followed by the Table 25 with respective descriptions and cardinalities.
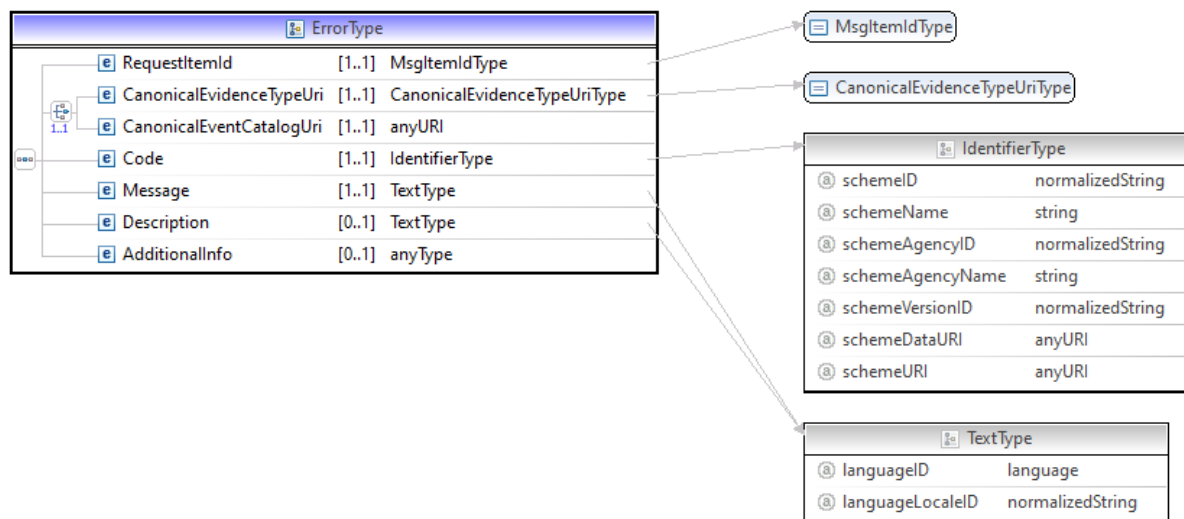

Figure 18: ErrorType elements

Table 25: List of concepts, their description, and respective cardinalities adopted in ErrorResponseItem elements

Field	Description	Cardinality
RequestItemId	Unique identifier of the request item within the corresponding request message that this response item is responding to.	1..1
CanonicalEvidenceTypeUri	Unique identifier of a canonical event catalogue according to the DE4A policy of identifiers when the request item corresponds to a subscription provision. To be used as a safeguard for the matching between request and response items since both items should be related to the same canonical evidence type.	1..1
CanonicalEventCatalogUri	Unique identifier of a canonical event catalogue according to the DE4A policy of identifiers when the request item corresponds to an event provision. To be used as a safeguard for the matching between request and response items since both items should be related to the same canonical event catalogue.	1..1
Code	The error code. It could be one of the agreed error code list for common errors. It could be also a code from a domestic error code list corresponding to a business error that is particular for the DO. The type of code list should be identified at least with the id of the agency that assigns the code.	1..1
Message	The error message. For common errors, associated messages can be available in every EU language because of	1..1

Field	Description	Cardinality
	the MOR; for domestic errors, associated messages need to specify the language of the text.	
Description	An optional error description. For common errors, associated descriptions can be available in every EU language because of the MOR; for domestic errors, associated descriptions need to specify the language of the text.	0..1
AdditionalInfo	For common errors, associated additional information can be available in every EU language because of the MOR; for domestic errors, associated additional information needs to specify the language of the text.	0..1

4.3   IEM Event Notification Message

Figure 19 illustrates the elements of the XML type for the IEM Event Notification message, followed by Table 26 and Table 27 with respective descriptions and cardinalities. This message is part of the Subscription & Notification pattern, so the DO of a canonical event catalogue can notify the corresponding events to the DEs subscribed to it regarding the data subject of the subscription.
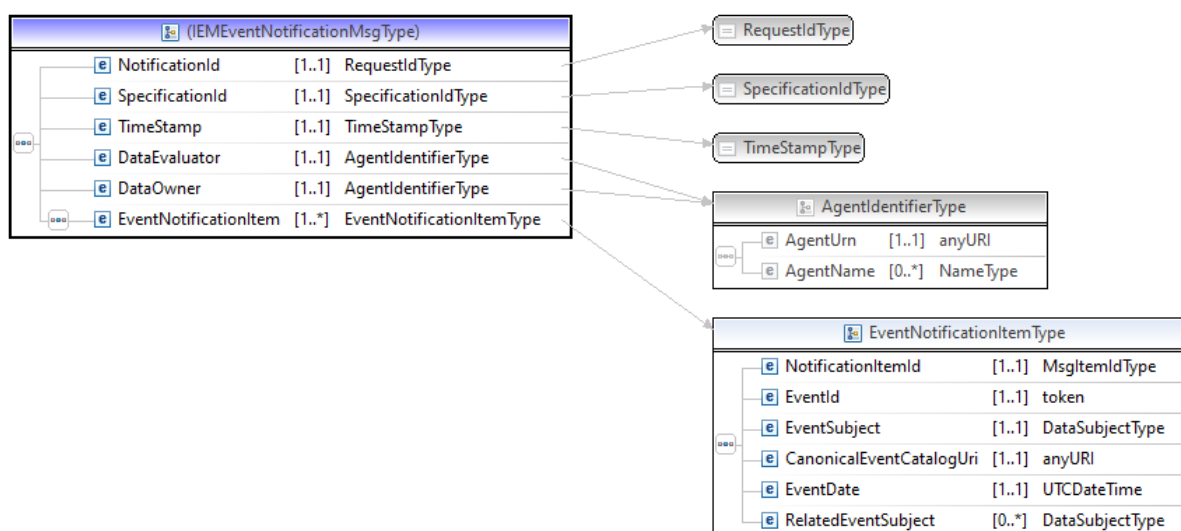

Figure 19: IEMEventNotificationMsdgType elements for IEM Event Notification messages

Table 26: List of concepts, their description, and respective cardinalities adopted in IEM Event Notification message elements

Field	Description	Cardinality
NotificationId	Unique identifier of the Event Notification Message (e.g., UUDI).	1..1
SpecificationId	Identifier of the IEM Event Notification Message specification.	1..1
TimeStamp	Day and time of the message sending.	1..1

Field	Description	Cardinality
DataEvaluator	URN according to the DE4A policy of identifiers and, optionally, the organization name. This is the addressee of the notification, who is subscribed to one of the DO's event catalogues.	1..1
DataOwner	URN according to the DE4A policy of identifiers and, optionally, the organization name. This is the notification sender.	1..1
EventNotificationItem	Notification Items that allow to include in the message more than one event notification from the DO to the DE.	1..*

Table 27: List of concepts, their description, and respective cardinalities adopted in the EventNotificationItemType

Field	Description	Cardinality
NotificationItemId	Unique identifier of the notification item within the event notification message (e.g., a sequential number).	1..1
EventSubject	The subject of the event. Either a natural person or a legal person represented by the eIDAS profile attributes (eIDAS datasets). To be used as a safeguard for the matching between the notification item and the corresponding former subscription item since both should be related to the same subject.	1..1
CanonicalEventCatalogUri	Unique identifier of a canonical event catalogue according to the DE4A policy of identifiers. To be used as a safeguard for the matching between the notification item and the corresponding former subscription item since both should be related to the same subject.	1..1
EventId	Token that identifies the event within the canonical event catalogue.	1..1
EventDate	Date and time when the specified event happened.	1..1
RelatedEventSubject	In some cases, the event not only involves the event subject but other subjects (e.g., companies merges).	0..*

5 General and Technical Documentation

WP3 collaborators use multiple tools for work collaboration and dissemination. Apart from internal tools for sharing work-in-progress data (OwnCloud repository and Google Drive shared folders), the publicly available deliverables are available via the official DE4A website, wiki pages and GitHub repositories.

5.1 WP3 GitHub Organisation

The WP3 organisation on GitHub [21] contains software-related and schema repositories (mostly models and schemas) and currently has 10 active WP3 members that contribute to the repositories. The current list of repositories contains:

▸ *doing_business_abroad*: Repository of canonical evidence for the Doing Business Abroad pilot.
▸ *moving_abroad*: Repository of canonical evidence for the Moving Abroad Pilot.
▸ *study_abroad*: Repository of canonical evidence for the Study Abroad Pilot.
▸ *IDKAPI*: Repository containing resources relevant to the IDK specification: IDK API definition, sample request/response messages, 2 stage response message for USI pattern, patterns for subscription & notification and look up.
▸ *IEM*: Multiple iterations of XML Schemas that are the basis for the design of IEM messages between Access Points.
▸ *MOR*: MOR component implementation that is designed as a general Web user interface for embedding directly into Member State portals. The component supports (a) explicit request page and (b) preview pages with interchangeable CSS and multi-lingual support. Current demo version is accessible at the DE4A project GitHub repository [21] .

5.2 DE4A Wiki

The DE4A project wiki [26] is used by WP3 to showcase work in progress. It reflects the current ongoing work (some unfinished content is also accessible in private pages) to develop deliverable contents and to review deliverables.

Figure 20 illustrates the wiki structure with respect to WP3 content. Since WP3 serves as a "*horizontal work package*" that provides support to and is tightly integrated with other work packages, the wiki cannot contain a "*silo-based*" structure per each work package. In this context, Figure 21 also demonstrates how the wiki interconnects content from different tasks and work packages.
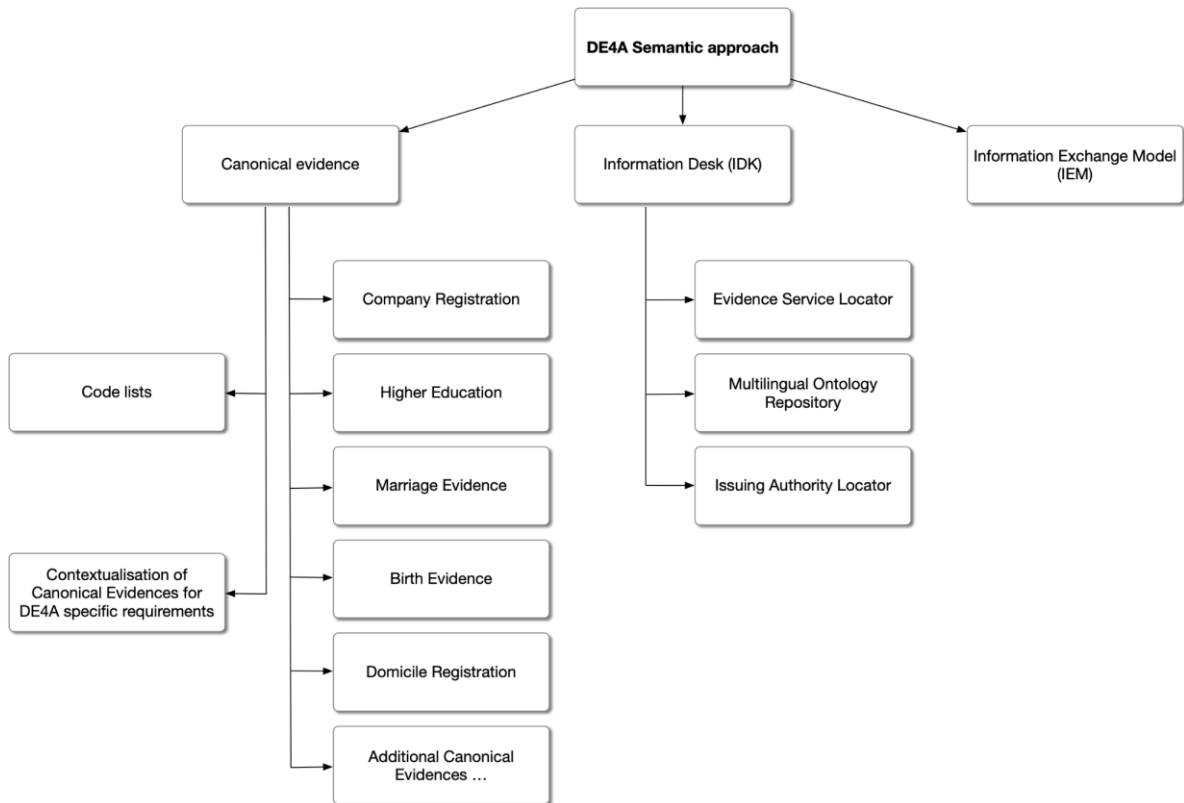
Figure 20: Work package 3 hierarchical structure of information in the DE4A wiki.
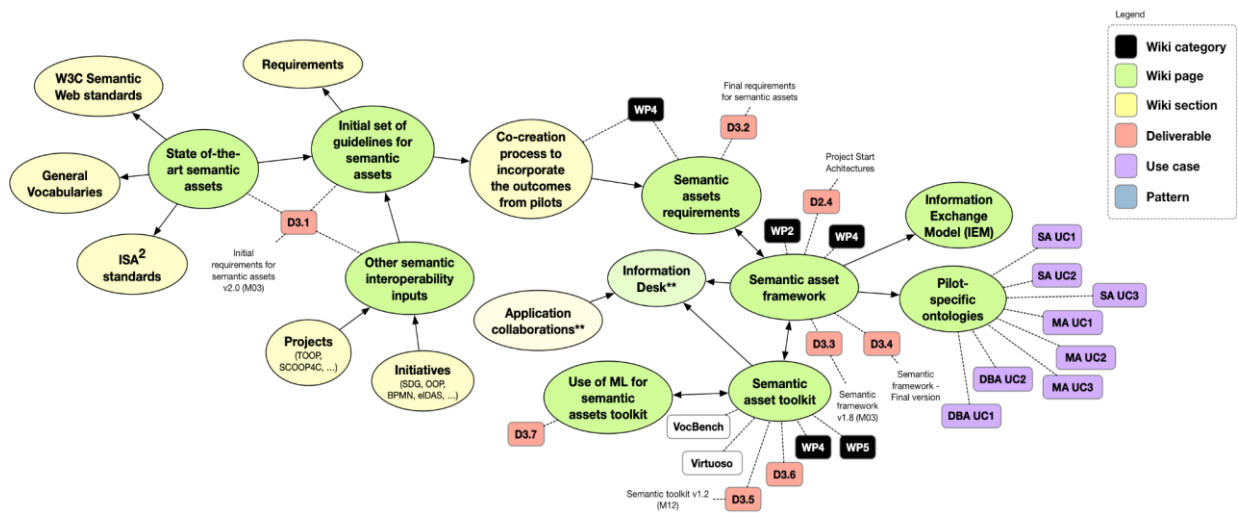
Figure 21: Interconnection of content between tasks and work packages in the DE4A wiki.

6 Conclusions

This deliverable presents the final version of the DE4A semantic layer stack toolkit for delivering cross-border public services related to the DE4A pilot use cases.

Using dedicated XML Schema editors and relevant software tools, DE4A implements models for representing canonical evidence types that introduce the required sets of attributes and cover the needs of the DE4A project pilots (chapter 2).

Furthermore, the final specification of the DE4A Information Desk component is presented, which facilitates Data Consumers and Data Providers to obtain the required information before making requests and/or sending responses to the respective stakeholders (chapter 3). The full implementation of the IDK is undertaken by DE4A WP5, but the OpenAPI specification of the Issuing Authority Locator and the implementation of the Multilingual Ontology Repository component with some simplifications, while the Cross-border Authority Authorisation Registry

component is not implemented but only designed in the final iteration of the project.

The deliverable also presents the final iteration of the Information Exchange Model for modelling the payload of request, response, and notification messages for the evidence exchange (chapter 4).

Finally, the channels for documenting the WP3 resources were presented, in the form of a dedicated wiki and a set of GitHub repositories (chapter 5).

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