The Once-Only Principle Project

Generic Federated OOP Architecture

(3rd version)

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Generic Federated OOP Architecture (3rd version)

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Abstract:

The deliverable "D2.3. Generic Federated OOP Architecture (3rd version)" is the third official version of the generic federated Once-Only Principle (OOP) architecture. It develops further and extends the deliverables "D2.1. Generic federated OOP architecture (1st version)" (D2.1) and "D2.2. Generic federated OOP architecture (2nd version)" (D2.2).

The OOP architecture contributes to implementing OOP in public administrations and supports the interconnection and interoperability of national registries at the EU level. It is aligned with existing EU frameworks (EIRA, EIF) and aims to contribute to the implementation act of the forthcoming regulation about the Single Digital Gateway (SDGR). The OOP architecture uses the results of the e-SENS European Interoperability Reference Architecture. It provides support for developers of OOP projects and is based on the Connecting Europe Facility (CEF) Digital Service Infrastructures (DSIs), on the Building Blocks consolidated by the e-SENS project, and in justified cases, on new building blocks.

Compared to D2.2, this deliverable provides new Business Architecture, Information System Architecture, and Technology Architecture views. It is complemented with specific views addressing cross-cutting quality concerns, such as Security Architecture and Trust Architecture. The deliverable has also been further aligned with the existing EU interoperability frameworks, such as EIRA and EIF.

The Architecture Principles and Architecturally Significant Requirements constitute the Architecture Drivers and Decisions. The Stakeholders section present the goal model of TOOP architecture, its target users and use cases, as well as main stakeholders.

The deliverable D2.3 is comprised of a textual component and a wiki component. The current document is the textual component of D2.3. The wiki component is an architecture repository providing an in-depth content on the architecture views; it is available on the TOOP D2.3 documentation space in Confluence (please see the Glossary). The next official deliverable related to the generic federated OOP architecture is D2.4 (M30, due June 2019).

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Changes between D2.2 and D2.3

Modification	Details
Restructuring and reworking the methodology, architecture, and deliverable	The structure and all components of D2.2 have been reworked and updated in D2.3, new components have been added. The D2.3 provides new Business Architecture, Information System Architecture, and Technology Architecture views. It is complemented with new views addressing cross-cutting quality concerns, such as Security Architecture and Trust Architecture. The deliverable D2.3 comprises the textual component and the wiki component. The current document is the textual component of D2.3. The wiki component provides an in-depth content on the architecture views. It is available on the TOOP D2.3 documentation space in Confluence (please see the Glossary).

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List of Abbreviations

Acronym	Explanation
ABB	Architecture Building Block
ABR	Access to Base Registries
ADL	Architecture Description Language
AI	Artificial Intelligence
ASR	Architecturally Significant Requirements
AT	Automated Translation
BB	Building Block
BPMN	Business Process Model and Notation
BRIS	Business Registers Interconnection System
CCTF	Common Components Task Force
CEF	Connecting Europe Facility
CEF DSI	The DSI financed by CEF
D2.1	TOOP deliverable "D2.1. Generic federated OOP architecture (1st version)"
D2.2	TOOP deliverable "D2.2. Generic federated OOP architecture (2nd version)"
D2.3	TOOP deliverable "D2.3. Generic federated OOP architecture (3rd version)"
DC	Data Consumer
DP	Data Provider
DSI	Digital Service Infrastructure
EC	European Commission
eID	Electronic Identification
eIDAS	electronic Identification and Signature (EU regulation)
EIF	European Interoperability Framework
EIRA	European Interoperability Reference Architecture
EO	Economic Operator
EES	ETSI Rationalised Framework for Enhanced Security Services
IS	Information System
IT	Information Technology

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JTF	Joint Technical Taskforce
JTG	WP3/WP2 Joint Technical Group
LSP	Large Scale Pilot
MA	Maritime Administration
IOP	Interoperability
OOP	Once-Only Principle
PA	Pilot Area
PKI	Public Key Infrastructure
PSC	Port State Control
SAT	Solution Architecture Template
SML	Service Metadata Locator
SBB	Solution Building Block
SDGR	Single Digital Gateway Regulation
TOOP	The Once-Only Principle Project
TOOPRA	The TOOP Reference Architecture
WP	Work Package

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Glossary

Term	Explanation
Application Architecture	A description of the structure and interaction of the applications as groups of capabilities that provide key business functions and manage the data assets (source: The Open Group 2011)
Architecture	Fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution (source: ISO/IEC 42010:2011)
Architecture description	An artefact used to express an architecture (source: ISO/IEC 42010:2011)
Architecture framework	Conventions, principles and practices for the description of architectures established within a specific domain of application and/or community of stakeholders (source: ISO/IEC 42010:2011)
Architecture view	An artefact expressing the architecture of a system from the perspective of specific system concerns (source: ISO/IEC 42010:2011)
Architecture viewpoint	An artefact establishing the conventions for the construction, interpretation and use of architecture views to frame specific system concerns (source: ISO/IEC 42010:2011)
Building Block	Represents a (potentially re-usable) component of business, IT, or architectural capability that can be combined with other building blocks to deliver architectures and solutions. Building blocks can be defined at various levels of detail, depending on what stage of architecture development has been reached. For instance, at an early stage, a building block can simply consist of a name or an outline description. Later on, a building block may be decomposed into multiple supporting building blocks and may be accompanied by a full specification. Building blocks can relate to "architectures" or "solutions". http://pubs.opengroup.org/architecture/togaf9-doc/arch/ (Ch.3)
Business Architecture	A description of the structure and interaction between the business strategy, organization, functions, business processes, and information needs (source: The Open Group 2011)
Competent Authority	'Competent authority' is a Member State body or authority established at either national, regional or local level with specific responsibilities relating to the information, procedures, assistance and problem-solving services.
Digital Service Infrastructure	CEF trans-European infrastructures based upon mature technical and organisational solutions, and aimed at supporting exchanges and collaboration with and within the public sector, across the EU
Evidence	\`Evidence\` means any document or data, including text or sound, visual or audiovisual recording, irrespective of the medium used, required issued by a competent authority to prove facts or compliance with requirements for procedures referred to in Article 2(2)(b). Source: SDGR, 14401/1/17 REV 1, Brussels, 28 November 2017
Information System Architecture	A description of the realization of the Business Architecture with IT components, and more specifically with the existing building blocks, as well as a description of the principles guiding the design of the IS architecture
Legal Entity	An association, corporation, partnership, proprietorship, trust, or individual that has legal standing in the eyes of law (http://www.businessdictionary.com/definition/legal-entity.html)
National registry	A data registry maintained by a Competent Authority

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Natural person	Please see "Person, Natural"
Once Only Principle	The public administrations should ensure that citizens and business supply the same information only once to a public administration
OOP architecture	A complex comprising the Generic Once Only Principle Reference Architecture and associated components, resulting from the TOOP project
OOP system	System based on the Once-Only Principle as applied in the TOOP project
Person, Legal	A legal person is a registered organization, having its registered office in a Member State. Reference: SDGR, 14401/1/17 REV 1, Brussels, 28 November 2017, Article 3(1)
Person, Natural	A natural person is a human, residing in a Member State. Reference: SDGR, 14401/1/17 REV 1, Brussels, 28 November 2017, Article 3(1)
Reference Architecture	Reference architectures are standardized architectures that provide a frame of reference for a specific domain, sector or field of interest (Proper and Lankhorst 2014). TOOPRA specific concern is the implementation of the OOP.
Scenario	One typical way in which a system is used or in which a user carries out some activity.
Technology Architecture	The Technology Architecture describes the logical software and hardware capabilities that are required to support the deployment of business, data, and application services. This includes IT infrastructure, middleware, networks, communications, processing, standards, etc. (source: The Open Group 2011)
TOOP D2.3 documentation space in Confluence	The space is provided on http://wiki.ds.unipi.gr/display/TOOPRA.
TOOP T2.1	TOOP Task 2.1, Federated Technical Architecture. T2.1 has a dual role. It is developing the TOOP Once Only Principle Reference Architecture, providing it in T2.1 deliverables. In parallel, T2.1 is prototyping, testing and participating in pilot implementations of the architecture, together with WP3, within the Common Components Task Force (CCTF) and in Joint Group Task Forces (JTF)
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	User is anyone who is a citizen of the Union, a natural person residing in a Member State or a legal person having its 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. Reference: SDGR, 14401/1/17 REV 1, Brussels, 28 November 2017, Article 3(1)
User story	Informal description of one or more system features from the user perspective

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Executive Summary

The Once Only Principle states that "*the public administrations should ensure that citizens and business supply the same information only once to public administration*": it is one of the pillars of the strategy for the Digital Single Market and one of the basic principles of the EU eGovernment Action Plan 2016-2020.

The Once-Only Principle Project (TOOP) aims to explore, demonstrate, and enable the Once Only Principle.

The achievement of this objective is supported by implementing three once-only pilot projects (TOOP pilots), by developing a generic federated OOP architecture, and by exploring other aspects of OOP and its supporting infrastructure such as legal landscape, OOP drivers and barriers, and sustainability.

TOOP focus area within the Once Only Principle implementation is on information related to business activities and on cross-border sharing of this information. The primary concern of the TOOP Reference Architecture (TOOPRA) developed within this project is to support the application of TOOP in this focus area, although its wider usage is not excluded. It builds on analysis of the TOOP requirements, on the experience of previous Large Scale Pilot (LSP) projects, and on the know-how gained with implementation of the TOOP pilots. As the TOOP project is required to support the implementation of the Single Digital Gateway Regulation (SGDR), the architecture has been aligned with SDGR provisions.

The main political and legislative principles underlying the OOP architecture are stated in the Annex 2 of the European Interoperability Framework Implementation Strategy (European Commission 2017). One of the main technical principles for development of the OOP architecture is the reuse of existing frameworks and building blocks provided by CEF, e-SENS, and other initiatives. The TOOP generic federated OOP architecture relies on such frameworks, on the European Interoperability Reference Architecture (EIRA) (Chou et al. 2015), the CEF Building Blocks, and the e-SENS deliverable D6.6 "e-SENS European Interoperability Reference Architecture", among others.

The OOP architecture contributes to implementing OOP in public administrations and supports the interconnection and interoperability of national registries at the EU level. It is aligned with existing EU frameworks (EIRA, EIF), is aimed to contribute to the implementation act of the forthcoming regulation about the Single Digital Gateway (SDGR) and uses the results of the e-SENS European Interoperability Reference Architecture. It provides support for developers of OOP projects and is based on the Connecting Europe Facility (CEF) Digital Service Infrastructures (DSIs), on the Building Blocks consolidated by the e-SENS project, and in justified cases, on new building blocks.

The current deliverable is the third official version of the generic federated Once-Only Principle (OOP) architecture. It develops further and extends the deliverables "D2.1. Generic federated OOP architecture (1st version)" (D2.1) and "D2.2. Generic federated OOP architecture (2nd version)" (D2.2).

The deliverable D2.3 is comprised of a textual component and a wiki component. The current document is the textual component of D2.3. The wiki component is an architecture repository providing an in-depth content on the architecture views; it is available on the TOOP D2.3 documentation space in Confluence (see Glossary).

The architecture has been developed using an exploratory and agile approach, in cooperation with the TOOP pilots and other TOOP Work Packages (WPs) and tasks. Compared to D2.2, this deliverable provides new Business Architecture, Information System Architecture, and Technology Architecture views. It is complemented with specific views addressing cross-cutting quality concerns, such as Security Architecture and Trust Architecture.

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The Architecture Principles (APs) and Architecturally Significant Requirements (ASRs) constitute the Architecture Drivers and Decisions. The Stakeholders section present the goal model of TOOPRA, its target users and use cases, as well as main stakeholders.

This deliverable is a work in progress. The next official deliverable related to the generic federated OOP architecture is D2.4 (M30, due June 2019).

1. Introduction

1.1.Scope and Objective of Deliverable

The Once Only Principle states that *"the public administrations should ensure that citizens and business supply the same information only once to public administration".*

The Once-Only Principle Project (TOOP) aims to explore, demonstrate, and enable the Once Only Principle. The achievement of this objective is supported by implementing three once-only pilot projects (TOOP pilots), by developing a generic federated OOP architecture, and by exploring other aspects of OOP and its supporting infrastructure such as legal landscape, OOP drivers and barriers, and sustainability.

TOOP focus area within the Once Only Principle implementation is on information related to business activities and on cross-border sharing of this information (Krimmer et al. 2017). The Generic Once-Only Principle Reference Architecture, developed within TOOP, relates primarily to applications in the TOOP focus area, although a wider usage is not excluded. It builds on the analysis of the TOOP requirements, on the experience of previous Large-Scale Pilot (LSP) projects, and on the know-how gained with implementation of the TOOP pilots. Due to the shift in the TOOP project focus requiring it to support implementation of the Single Digital Gateway Regulation - SGDR (European Union 2017), the current version of the OOP architecture has been aligned with SDGR provisions.

The current deliverable is the third official version of the generic federated Once-Only Principle (OOP) architecture. It develops further and extends the deliverables "D2.1. Generic federated OOP architecture (1st version)" (D2.1) and "D2.2. Generic federated OOP architecture (2nd version)" (D2.2).

The deliverable D2.3 comprises the textual component and the wiki component. The current document is the textual component of D2.3. The wiki component provides an in-depth content on the architecture views, cross-cutting concerns, stakeholders, and the architecture drivers and decisions, and is available on the TOOP D2.3 documentation space in Confluence (see Glossary).

The architecture has been developed using an exploratory and agile approach, in cooperation with the TOOP pilots and other TOOP Work Packages (WPs) and tasks. Compared to D2.2, this deliverable provides new Business Architecture, Information System Architecture, and Technology Architecture views. It is complemented with specific views addressing cross-cutting quality concerns, such as Security Architecture and Trust Architecture.

The Architecture Principles (AP) and Architecturally Significant Requirements (ASRs) constitute the Architecture Drivers and Decisions. The Stakeholders section present the goal model of TOOPRA, its target users and use cases, as well as main stakeholders.

This deliverable is a work in progress. The next official deliverable related to the generic federated OOP architecture is D2.4 (M30, June 2019).

1.2.WP2 General Objectives and Vision

According to (Krimmer et al. 2017), the benefits expected from the project are: a better-functioning digital single market, with increased customer satisfaction and a better image of public authorities, allowing to get:

- time savings,
- lowering the administrative burden and reducing costs for business,
- fulfilling legal obligations faster,
- improved service quality and administrative efficiency.

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WP2 approach aims to capture TOOP pilots results and add value by generalising and formalizing it for further use. WP2 is serving abovementioned goals through offering usable high-level views to capture enablers, barriers and principal design of developed technical solutions in one coherent documentation set. Due to the innovative nature of the project, the content and coverage of this set is highly experimental, subject to continuous development and might serve as a blueprint for developing similar cross-border solutions.

More specifically addressing the goals listed above, time savings for public authorities could be gained through following TOOP development patterns and Generic Architecture defined principles. Reduced administrative burden and costs can be achieved by using standard solution blocks, identified with help of Reference Architecture. Generic Architecture, Reference Architecture and standard solution blocks are designed in line with legal requirements. Improved service quality and efficiency is accessible through tested, mature, interconnected and interoperable TOOP standard building blocks.

The general objectives of TOOP WP2 (Technical Architecture, Legal and Governance Aspects) are to develop a generic, federated OOP architecture, to identify general legal barriers and drivers regarding privacy, confidentiality and consent needed for the implementation of OOP, to assess the possible impacts of the implementation of OOP in the pilots in WP3, as well as to define a sustainability plan for the maintenance of the architectures, building blocks and drivers/barriers after the end of the project.

The results of WP2 work represent the main technological innovation of TOOP: the generic federated OOP architecture that supports the interconnection and interoperability of national registries at the EU level - together with other investigations needed to generalize, extend, and sustain the TOOP results.

1.3.Methodology of Work

The methodology of work follows from TOOP aims and activities. This project implements three TOOP pilots, develops a generic federated OOP architecture, supports implementation of the Single Digital Gateway Regulation, and explores other aspects of OOP and its supporting infrastructure such as OOP drivers and barriers. The architecture described in this deliverable is qualified as a

- Generic Architecture and a
- Reference Architecture.

The architecture is generic, as it is designed by abstracting from domain specificities and identifying the common elements associated with the problem domain (the Once-Only Principle). It is part of an architecture continuum, as defined in The Open Group's Architecture Framework (TOGAF)[1] (The Open Group 2011), which allows to move from a generic architecture to a domain-specific and a pilot-specific architecture. TOGAF is chosen because it is open source and accessible for all the interested parties without additional costs, thus in coherence with European Commission strategy for internal use of Open Source Software (https://ec.europa.eu/info/departments/informatics/open-source-software-strategy_en).

TOGAF Architecture Development Method (ADM) is a proven Enterprise Architecture methodology, ensuring consistent standards, methods, and communication among Enterprise Architecture professionals. TOGAF 9.2 considers an "enterprise" to be any collection of organizations that have common goals (section 1.3). Given that TOOP aims to connect different governmental services originating from different EU member states, the Enterprise that TOOP has in scope is *a group of*

[1] http://www.opengroup.org/public/arch/p3/ec/ec_ac.htm

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loosely linked independent governmental entities that collaborate to achieve common a goal, which is defined by OOP principles.

The architecture described in this deliverable is a Reference Architecture, as opposed to a solution architecture: Reference Architectures "capture the essence of existing architectures, and the vision of future needs and evolution to provide guidance to assist in developing new solution architectures" (Cloutier et al. 2010). Reference architectures are standardized architectures that provide a frame of reference for a particular domain, sector or field of interest (Proper and Lankhorst 2014): in the case of TOOPRA the main concern is supporting the OOP. Reference models or architectures provide a common vocabulary, reusable designs and industry best practices. They are not solution architectures, i.e. they are not implemented directly. Rather, they are used as a constraint for more concrete architectures. Typically, a reference architecture includes common architecture principles, patterns, building blocks and standards.

The TOOP Reference Architecture (TOOPRA) is developed in cooperation with the TOOP pilots and other TOOP Work Packages. The main pilot design activities are done in TOOP WP3, and more specifically in the Common Components Task Force (CCTF), which is responsible for designing the common components to be used in the pilots. TOOP T2.1 is prototyping, testing and participating in pilot implementations of the architecture together with WP3 within the CCTF and in Joint Group Task Forces (JTF). The TOOPRA builds on the know-how gained with designing the TOOP pilots and experience of previous Large Scale Pilots (LSP), especially the reusable building blocks constituting the Digital Service Infrastructure (DSI). The TOOPRA also contributes to the TOOP pilot design and to the modification and development of the DSI.

1.4.Relations to Internal TOOP Environment

The TOOP T2.1 members are simultaneously contributing to several parallel processes: developing further the architecture; delivering T2.1 deliverables in specified deadlines; participating within the WP3/WP2 Joint Technical Group (JTG), the Common Components Task Force (CCTF), and the Joint Technical Taskforces (JTF). The current deliverable presents the results of the architecture development process, evaluates and extends the pilot outcomes, exchanges best practice results with other WP2 tasks, and provides architecture-related support to WP3 within the scope of task T2.1.

Specific instantiations of the architecture are being implemented in development of the TOOP pilot projects in WP3. The architecture is partially based on the interaction between WP2 and WP3, on the questionnaire and information provided with respect to other tasks in WP2, and other sources. Maintaining and further development of the architecture will be planned by the Sustainability and Governance task of WP2.

Inputs to this deliverable were received from the EU official sources, from CEF Building Blocks, from deliverables and wikis of the e-SENS project, from TOOP WP3, from desk research, from architecture guidelines, frameworks, standards, and from other sources.

This architecture is aimed at guiding the designers and developers of pilot applications in WP3 and the stakeholders who will develop applications to support the interconnection and interoperability of national registries at the EU level and provide implementation of the Single Digital Gateway Regulation.

1.5.Relations to External TOOP Environment

This deliverable reports the results produced by TOOP WP2. These results represent the main technological innovation of TOOP - the generic federated OOP architecture. This architecture supports the interconnection and interoperability of national registries at the EU level. It is in line with existing EU frameworks (EIRA, EIF) and takes into account the e-SENS European Interoperability Reference

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Architecture. It provides input for SDGR implementation and is oriented towards reuse of the CEF DSIs and the Building Blocks consolidated by the e-SENS project.

1.6.Legal Issues

Several legal issues had to be clarified when writing the deliverable. These issues were related to European legislation, as well as to national legislation in Member States and Associated Countries that are participating in the WP3 pilots. The solutions found (see TOOP Deliverable D2.5, 2017) allowed to conclude that it is possible to build the generic federated OOP architecture in line with existing EU frameworks and Building Blocks such as the European Interoperability Framework, the European Interoperability Reference Architecture, the Single Digital Gateway Regulation, the CEF Building Blocks, and the e-SENS Building Blocks.

1.7.Structure of the Document

Introduction, the first chapter of this document, states the scope and objectives of the deliverable and the TOOP WP2, its methodology, relations to TOOP internal and external environments, and other issues.

The architecture design methodology, including its motivation, framework, process, and requirements analysis are analysed in the second chapter.

The third chapter presents the summary of the TOOP Reference Architecture, including three architecture views (Business Architecture, Information System Architecture, Technology Architecture), description of the architecture repository, and link to the architecture models.

The fourth chapter provides a set of the TOOP Reference Architecture life cycle management processes, with the aim of providing a better support to stakeholders, fostering user adoption of the architecture, and enhancing transparency of its change management.

The state of the cooperation of the TOOP Architecture team with other relevant EC Initiatives is presented in the fifth chapter.

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2. Architecture Design Methodology

The initial purpose of the OOP architecture was to aid development of specific information systems architectures supporting the Once-Only Principle. After SDGR was introduced in April 2017, the TOOP project was additionally given the task to provide input to the SDGR Implementing Act. This means that the architecture had to take into account new requirements emerging from SDGR.

The TOOPRA is therefore developed by combining top-down and bottom-up approaches:

- The Once-Only Principle and its legal environment, specifically the “SDGR draft”, as well as the user requirements from the “Member States” (i.e. pilots), guide the design of the architecture;
- The existing frameworks and building blocks provided by “CEF DSI”, e-SENS, and other initiatives, together with TOOP “Common Pilot Solution Architecture”, are designed artefacts that are injected within the architecture where appropriate and support the design of the architecture.

The Figure 1 graphically represents this combined approach, including the expected outcomes of TOOPRA: on one hand it should be a blueprint for the OOP systems and the implementing acts based on SDGR, on the other hand it should contribute to both the pilot architecture and the DSI. Note that the TOOP “Common Pilot Solution Architecture” also interacts with the “Member States” and the “CEF DSI”; however, these interactions focus more on implementation aspects, while the interactions with the TOOPRA are on architectural aspects.

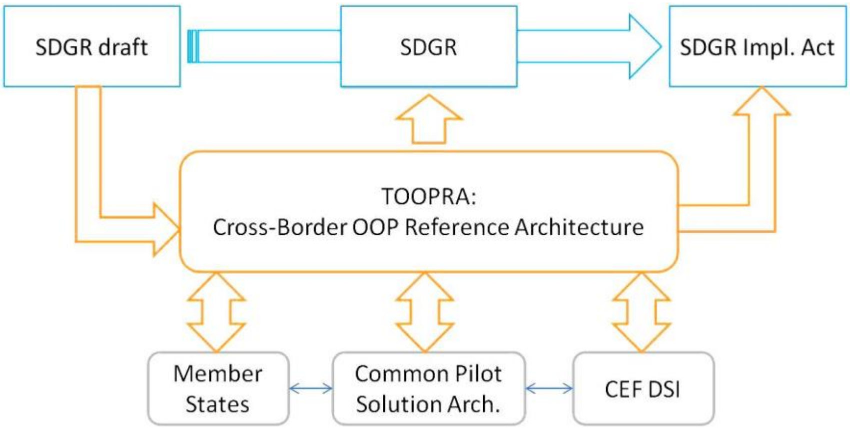

Figure 1: Context of TOOP Architecture Design

2.1.Architecture Development Motivation, Target Users, Use Cases

2.1.1. Architecture Development Motivation

The motivation behind architecture development is to share some best practices for cross-border solution development through high-level, architectural descriptions, laying the foundations for the future developments of the wide set of different high-quality cross-border solutions.

Administrations can benefit from the existence of a generic architecture since they can select solutions without reference to a vendor. The architectural model can be included in the technical specifications of a call for tender and this should reduce vendor lock in.

A generic architecture opens the market to a multiplicity of compliant solutions and to a multiplicity of vendors, lowering the entrance barriers for the SMEs and fostering competition. This should also

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lower the prices of procuring an OOP service for administrations and improve quality of OOP services for citizens.

EC can benefit from the TOOPRA since the existence of a reference architecture should make the development process of an OOP service more effective and efficient.

The direct beneficiaries are the users of the architecture, which are a special category of stakeholders, since they are interested in the quality of the architecture but also in its usability and other architectural qualities.

Another approach is to classify beneficiaries according to the temporal aspects of their interest. Different interest groups are involved in different time periods, thus making unified approach even more challenging. For example, TOOP project managers are involved during TOOP project time; architects and developers focus on the outcome after the project has finished but before launching new cross-border services; businesses are involved after this period and so forth. Each of these interest groups has different expectations and requirements upon the project outcome.

Therefore, a simple separation is made to distinguish between wider TOOP project related interest groups (hereby classified as Stakeholders) from direct users of TOOP Reference architecture (TOOPRA target users).

2.1.2. Stakeholders

Architecture development motivation is presented from two viewpoints: stakeholders and users. Stakeholders do form a wider spectrum of all interest groups, whilst direct users of TOOP architecture are considered as target audience for using this document. Stakeholders are divided into next main groups.

Key roles and responsibilities within the project:

- **TOOP managers** are the people involved in planning and managing the project and ensuring smooth delivery of the project outcomes. Indirectly this group involves also EU top level officers, developing legislation regarding Single Digital Market Regulation and ensuring cross-border public data and services movement.
- **TOOP implementors** are persons directly responsible for planning and development of solutions enabling cross-border public data and services movement. This involves public officials, architects, analysts and developers, using TOOP project results as blueprint for creating forthcoming software solutions in similar scale.
- **Prospective service users** are citizens and business, going to use cross-border public data and services movement enabling software solutions. This is the main stakeholder's group for whom this initiative should serve, ensuring delivery of highly efficient and user-friendly software solutions in the close future.

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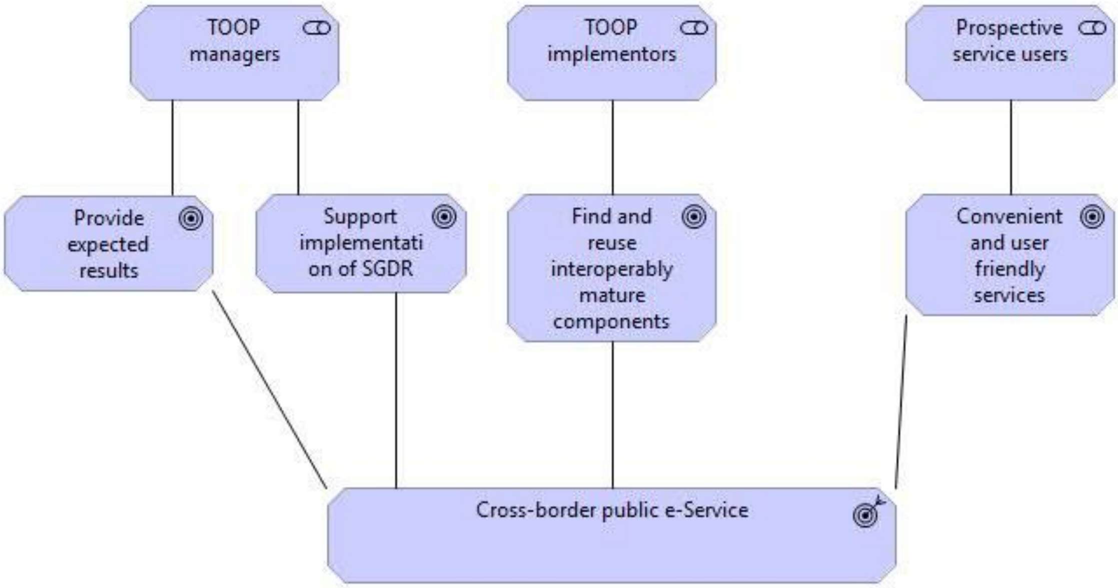

Figure 2: The TOOPRA goal model

2.1.3. TOOPRA target users

The target users of the architecture are the present and future developers of EU eGov services, which will benefit from the existence of a generic reference architecture TOOPRA in two ways:

1) they have a reference model that guides the selection of the relevant building blocks (architecture as a Solution Architectural Template)

2) they can test their solutions for compliance against architecture (architectural compliance).

In addition to the target users we should also consider the possible stakeholders, which are the people that can receive direct or indirect benefits from the existence of TOPRA.

A first list of stakeholders has been identified during the early phases of the project.

Target users do form a special group of stakeholders, holding specific interest toward TOOP Reference Architecture. The documentation, reflecting the development of different level and universal/reusable building blocks is expected to serve target users in multiple ways. The TOOP has the objective to support users in the following scenarios.

- Designing: accelerate the design EU wide software solutions that support the delivery of interoperable digital public services (across borders and sectors).
- Assessing: provide a reference model for comparing existing architectures in different Member States, to identify focal points for convergence and reuse.
- Communicating and sharing: help documenting the most salient interoperability elements of complex solutions and facilitate the sharing of (re)usable solutions.
- Discovering and reusing: ease the discovery and reuse of interoperability solutions.

The main categories of TOOP Reference Architecture users are as follows.

- **Architects,** Enterprise Architects as well as Solution Architects, that are responsible for the design of cross-border solution architectures.
- **Portfolio managers** responsible for maintaining the catalogue of assets related to the design and implementation of eGovernment solutions and for making investment decisions on these assets.

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- **Business analysts** responsible for assessing and to study the impact of changes in the (external) environment on IT systems.
- **Developers** responsible for design, development and implementation of software solutions for interoperable digital public services (across borders and sectors).

The TOOPRA users are involved in the following main use cases (Figure 3).

- Design and document cross-border solution Architectures architecture use case
- Compare cross-border solution architectures use case
- Create portfolio of solutions use case
- Manage portfolio of solutions use case
- Rationalise portfolio of solutions
- Support impact assessment on ICT use case
- Design, develop and implement

Detailed descriptions of the use cases, as well as a stakeholder list containing three levels of stakeholders are given in the TOOP D2.3 wiki component in Confluence.

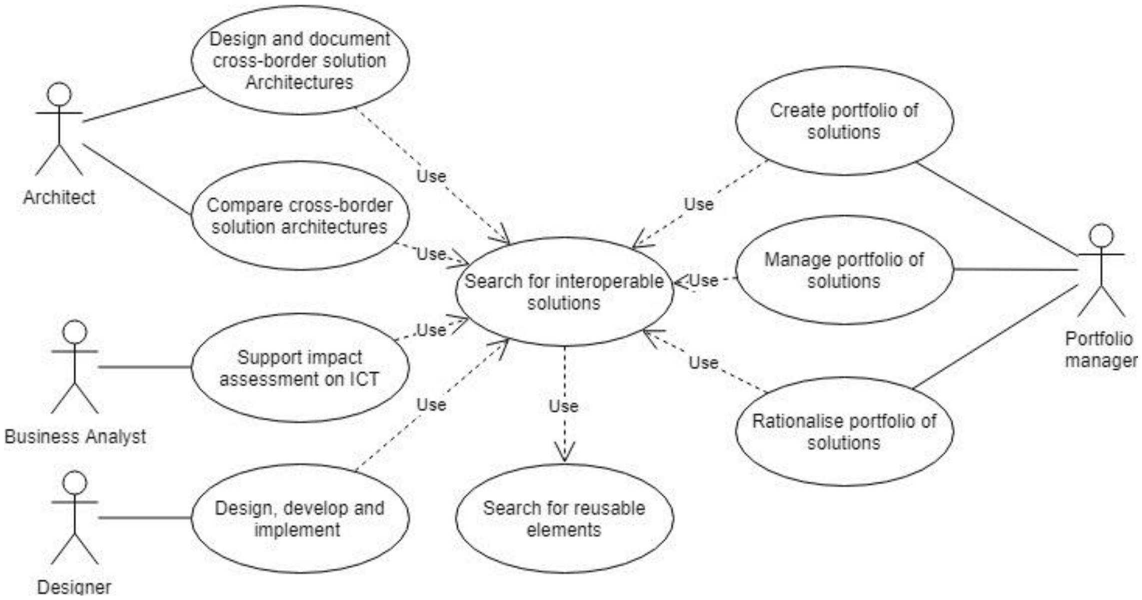

Figure 3: Target users and their use cases within the TOOPRA

2.2.Architecture Description Framework

An architecture description is an artefact describing the architecture for some system of interest. In ISO/IEC/IEEE 42010, system refers to man-made and natural systems, including software products and services and software-intensive systems.

Frameworks conforming to the standard often include processes, methods, tools and other practices beyond those specified above. The two most well-known examples of architecture frameworks are TOGAF and Zachman's information systems architecture framework[2] (Zachman 2008).

The TOOPRA description is organized along the following architecture views, adopted from TOGAF framework (illustrated in Figure 4): the business view (**Business Architecture**), concerned with the business operations of the TOOP system, the IS view (**IS Architecture**), concerned with the realization

[2] https://en.wikipedia.org/wiki/Zachman_Framework

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of the business operations with information systems, and the technology view (**Technology Architecture**), concerned with the logical software and hardware capabilities that are required to support the IS architecture. They are complemented with specific views addressing cross-cutting quality concerns, such as security architecture and trust architecture. The architecture drivers and decisions comprise the architecture principles (AP) and architecturally significant requirements (ASRs). The stakeholders component presents the goal model of TOOPRA, its target users and use cases, as well as main stakeholders.

The domain model (the architecture domain definition and description) has been provided in the TOOP D2.2 deliverable. The environment and the context of the Once-Only domain affects the architecture by providing relevant knowledge and information that guides the design of the architecture. The political and legal environment, the pilot (and other relevant) requirements, as well as the architecture patterns and other elements of the architecture and design body of knowledge have been the main external elements considered in the TOOP architecture deliverables.

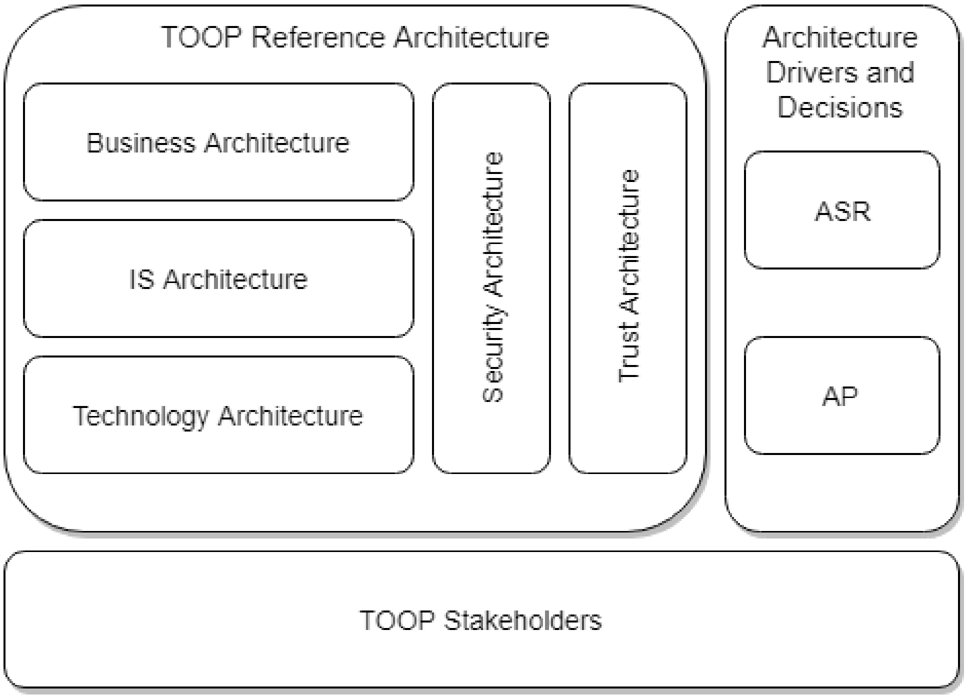

Figure 4: Generic Reference Architecture Description Framework

2.3.Architecture Design Process

Figure 5 shows the principal activities within the TOOP architecture development process, together with their outputs.

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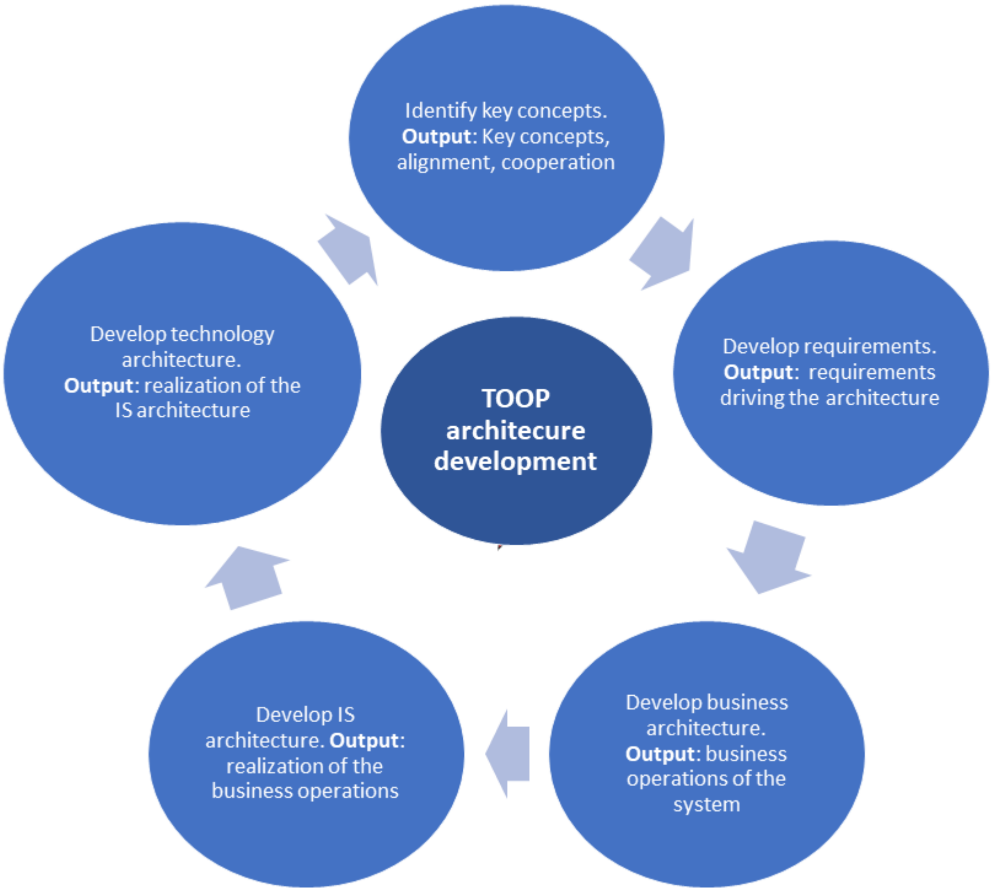

Figure 5: Activities within the TOOP architecture development process

The architecture deliverable development follows an incremental approach, involving four official versions (D1.1, D2.2, D2.3, D2.4) and two interim versions. The current document is the third official version and will be developed further in the next edition. To the reasonable extent, duplication of content from previous deliverable versions has been avoided in D2.3; however, in each consecutive version of the architecture deliverable, some components from the previous versions may be added, some components may be developed further or modified, and some components may be left unchanged.

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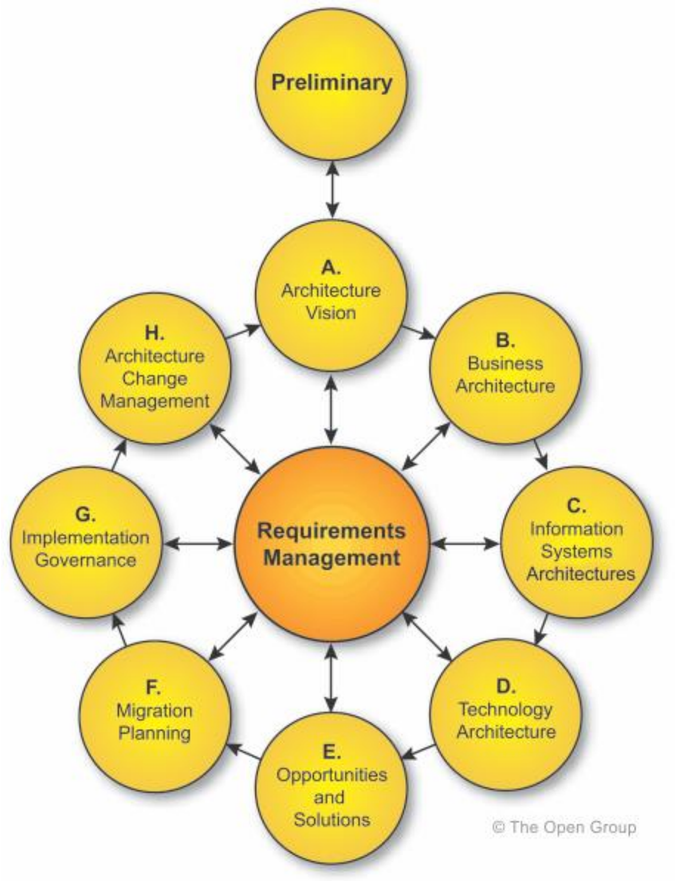

Figure 6: TOGAF Architecture Development Cycle

For the development process of the generic, federated OOP Architecture, the Architecture Development Method (ADM) of TOGAF9.1[3] was adopted. This methodology follows a cyclic approach towards the development of an architecture, its implementation and maintenance (see the figure). In the development of D2.3, a complete TOGAF ADM cycle was not adopted, since TOGAF does not mandate a complete cycle - the focus has been on phases from A to D. TOGAF was used as a methodology to improve the quality of the product (D2.3) with the aid of a structured reference process, therefore the selected TOGAF phases have not been reported in the deliverable. The deliverable was not intended as a TOGAF application exercise.

A mapping between the TOGAF steps and the D2.3 chapters loosely the following:

TOGAF Preliminary Phase --> D2.3 Introduction

TOGAF Phase A "Architecture Vision Phase" --> D2.3 Architecture Methodology

TOGAF PHASE B --> D2.3 3.1.1 Business Architecture

TOGAF PHASE C --> D2.3 3.1.2 Information Systems Architecture

TOGAF Phase D --> D2.3 3.1.3 Technology architecture

[3] http://pubs.opengroup.org/architecture/togaf9-doc/arch/

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All these phases have involved some cycles through the TOGAF Requirement Management Phase. The E-H phases were applied in the selection and evolution of the existing Building Blocks from previous projects and CEF, but not in depth. These phases will lead the evolution of D2.3 into D2.4. In relation to the TOGAF architecture framework, Archimate3.0[4] specification has been used as an architecture description language (ADL).

2.4.Requirements Analysis

The requirements of interest in designing TOOP Reference Architecture are the **Architecturally Significant Requirements** (ASR's), i.e. "those requirements that have a measurable impact on a software system's architecture" (Chen, Babar, and Nuseibeh 2013). Significant is a key term in this definition and is ultimately measured by high cost of change in the designed architecture.

The ASR's are specified by referring to concepts and elements of the domain model: the requirements are indeed guiding the solution to be designed to solve the problem domain. ASR's will therefore refer to an actor/role's capability, as captured in the domain model.

Besides the ASR's, **architecture principles** are also captured: they are "underlying general rules and guidelines for the use and deployment of all IT resources and assets across the enterprise" (TOGAF). They reflect a level of consensus among the various elements of the enterprise and form the basis for making future architecture decisions.

A principle differs from a requirement by its scope: it is a general rule applied to any element of the designed architecture. Some architecture principles might be the source from which architecture requirements are derived. The architecture principles however remain key guidelines driving the architecture decisions and might be referred to at any stage of the architecture design (from business architecture to technology architecture).

Both the ASR's and the Architecture Principles are structured according the standard Software/System Product Quality Model (ISO/IEC 25010) and the related Data Quality Model (ISO/IEC 25020), both part of the Software Quality Requirements and Evaluation (SQuaRE) family of standards. Adopting a standard structure contributes to ensuring that all relevant architecture concerns are integrated and to identifying potential lack of expressed needs from the stakeholders: a relevant quality attribute that is not associated with any requirement might represent a gap in the requirements engineering process, seen from the viewpoint of the architect.

Table 1 identifies the relevant quality attributes in the context of TOOP: these are the concerns for which requirements and/or principles should be specified.

Table 1: Relevant Quality Attributes

Quality Attribute	Relevance and specific goals in TOOP
System Quality	
Functional Suitability	The domain model (actors/roles and collaboration model) is the baseline for the functional suitability dimension. It is complemented with functional requirements associated with the capabilities of each domain participant.

[4] http://pubs.opengroup.org/architecture/archimate3-doc/

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Quality Attribute	Relevance and specific goals in TOOP
Performance Efficiency	The performance is mainly relevant from the **time-behaviour** perspective (i.e. the degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements), associated with the end-to-end processing time of the user request. The **capacity** might also be relevant, in terms of size of data to exchange, as well as in terms of transaction **throughput**
Compatibility	The compatibility quality dimension is concerned with **interoperability**, from the perspective of both the exchange of information and the use of exchanged information. The **coexistence** attribute is relevant in terms of integration with existing MS systems and the compliance with the principle of subsidiarity.
Usability	The **operability** of the system is the main concern: it especially relates to the cross-border exchange. Moreover, **accessibility** is a compulsory requirement, especially in terms of European languages.
Reliability	The reliability is mainly concerned with the **availability** of the system, and specifically of the cross-border exchange.
Security	Security is a main concern in TOOP, as the system deals with the exchange of authenticated data and authorized access to the data. The requirements are associated with **confidentiality**, **integrity**, **availability (of the information)**, **nonrepudiation**, **accountability**, **auditability**, **authenticity/trustworthiness**, as well as **privacy**.
Maintainability	Although **modularity** and **reusability** are of paramount importance to ensure maintainability, they are not directly concerned with the architecture of the system (but with the detailed design of the solution).
Data Quality	
Accuracy	**Syntactic** and **semantic** accuracy of the exchanged data are particularly important in TOOP.
Completeness	The completeness of data cannot be guaranteed on the TOOP architecture level as the TOOP does not include the collection and validation of data about the data subject from the data owner.
Consistency	The consistency of data is ensured by the systems that the TOOP architecture relies on. TOOP in itself cannot therefore ensure the data consistency.
Credibility	The authenticity of data is a major concern in the cross-border exchange of evidence. TOOP should ensure that the authenticity is maintained during the exchange.
Currentness	Evidence can be updated during its lifecycle. The currentness of data is ensured by the systems that the TOOP architecture relies on. TOOP has to integrate this and provide a mechanism to ensure the use of current data.

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The ASR's and Architecture Principles specifications are the outcome of a standard requirements engineering process, composed of the following activities:

- Requirements inception
- Requirements analysis
- Requirements specifications
- Requirements validation

The activities are contextualized, both to the scope of the project and to the goal of designing a reference architecture (as opposed to an application architecture). The contextualized activities and their outcomes are described in the following sections.

2.4.1. Architecture Requirement Inception

During the inception phase, the needs of the stakeholders are captured: they are the baseline for the specifications of the requirements. In TOOP, the needs are issued from the following sources:

- The legal environment and specifically the draft SDGR;
- The interoperability principles and recommendations (extracted from the EIF);
- The pilot needs.

The needs of the stakeholders are captured by other WP and/or tasks. The main sources of these needs are:

- Legal principles and requirements (D2.5)
- Draft SDGR[5]
- EIF Principles and Recommendations[6]
- User requirements issued by each pilot and available on the pilot wiki[7]

2.4.2. Architecture Requirement Analysis

In this phase, the requirements from each source is analysed and its impact on the architecture is assessed. The result of this assessment might be that

- The requirement is not relevant in terms of architecture
- The requirement is either generalized or specialized in an architecture principle
- The requirement is generalized in an architecture requirement

Annex I of D2.2 describes the outcome of the legal framework analysis, while Annex II of D2.2 describes the outcome of the EIF analysis.

2.4.3. Architecture Principles Specifications

In this phase, the identified architecture principles are formulated and associated with the quality model. The specified architecture principles are traced back to their sources (e.g., 'EIF-04' refers to EIF Recommendation 4).

[5] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52017PC0256

[6] https://ec.europa.eu/isa2/eif_en

[7] http://wiki.ds.unipi.gr/display/TOOPPILOTS/

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Table 2: Architecture Principles[8]

ID	Name	Description	Rationale	Quality attributes	Implications
PRINC-01	Open specifications and standards	To ensure technical interoperability, give preference to open specifications and standards in the design of the cross-border evidence exchange system, taking due account of the coverage of functional needs, maturity and market support and innovation	EIF-04 EIF-33	Reusability Interoperability	If a new component is to be designed, give preference to open specifications and standards
PRINC-02	Reusable solutions	Design TOOP Architecture as a Reference Architecture, which can be reused as a template to develop the various solutions architectures. Include the reuse of existing building blocks when relevant.	EIF-06	Reusability	Develop TOOP architecture as a reusable solution; reuse BB when possible
PRINC-06	Once Only Principle	Adhere to the Once Only Principle in the design of the Reference Architecture for SDGR	EIF-13	Operability	The Once Only Principle helps to meet the users' requirement to provide only the information that is absolutely necessary to obtain a given public service
PRINC-07	Standards and specifications process	Put in place processes to select relevant standards and specifications,	EIF-21	Interoperability	Standards and specifications are fundamental to interoperability.

[8] Numbering of Architecture Principles is kept from earlier iterations of the deliverable, however, some of the principles have been removed from the table.

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		evaluate them, monitor their implementation, check compliance and test their interoperability			Their management process needs to be established together with architecture development
PRINC-08	Standards and specifications selection	Use a structured, transparent, objective and common approach to assessing and selecting standards and specifications	EIF-22	Interoperability	A structured, transparent, objective and common approach to the standards and specifications process should be developed
PRINC-09	Interoperability agreements	Establish interoperability agreements in all layers, complemented by operational agreements and change management procedures	EIF-26	Interoperability	Interoperability agreements in all layers, complemented by operational agreements and change management procedures, are needed to implement TOOP architecture and should be foreseen
PRINC-10	Organisational relationships	Clarify and formalise organisational relationships between the participants in the Once-Only processes	EIF-29	Interoperability	Clarification and formalization of organisational relationships between stakeholders are needed to implement TOOP architecture and should be foreseen
PRINC-13	Infrastructure for European public services	Decide on a common scheme for interconnecting loosely coupled service components and put in place and maintain the	EIF-35	Interoperability	Infrastructure for establishing and maintaining European public services should be decided,

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		necessary infrastructure for establishing and maintaining European public services			developed, and put in place
PRINC-14	Reusable services and information sources	Develop a shared infrastructure of reusable services and information sources that can be used by all public administrations	EIF-36	Interoperability	The infrastructure for establishing and maintaining European public services should comprise reusable services and information sources that can be used by all public administrations
PRINC-15	eIDAS Trust Services	The TOOP architecture should use trust services according to the Regulation on eID and Trust Services as mechanisms that ensure secure and protected data exchange in public services	EIF-47	Security	Mechanisms are in place to ensure secure and protected data exchange in public services
PRINC-16	Data Minimization	The information exchanged between the participants of the system should be limited to the data required by the processing	Privacy-by-Design	Privacy	Privacy risks are reduced due to data minimization
PRINC-17	Purpose Limitation	The information exchanged between the participants of the system should only be used for the explicitly agreed purpose	Privacy-by-Design	Privacy	Privacy risks are reduced due to using information only for the explicitly agreed purpose
PRINC-18	Consent Management	When the consent of the user is	Privacy-by-Design	Privacy	Privacy risks are reduced due to

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		necessary for data protection purposes, it shall be obtained in accordance with Regulation (EU) 2016/679 and Regulation (EU) 45/2001			obtaining the consent of the user where necessary
PRINC-19	Semantic Mediation	A guide to the terminology used and/or a glossary of relevant terms used in each base registry should be made available for both human and machine-readable information purposes. Develop interfaces with base registries and authoritative sources of information, publish the semantic and technical means and documentation needed for others to connect and reuse available information.	EIF 37-39	Interoperability	A shared representation of the information available in authoritative sources should be in place, both for human and machines

2.4.4. Architecture Requirements Specifications

In this phase, the identified requirements are formulated and associated with the quality model. The specified architecture requirements are traced back to their sources. The resources are:

- Pilot Areas, e.g. 'PA1.1-REQ-8' refers to TOOP Pilot Area 1.1 requirement REQ-8, 'PA2.1-DATA-2' refers to TOOP Pilot Area 2.1 requirement DATA-2.
- EIF recommendations e.g. 'EIF-45' refers to recommendation 45.
- SDGR e.g. 'SDGR.Art12.4' refers to draft SDGR article 12.4.
- Legal requirements from D2.5 e.g. 'LEG-GA-03' refers to Good administration requirement 3, 'LEG-CTRL-02' refers to Control requirement 2.
- Principles from the previous section e.g. PRINC-18.

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Table 3: Architecture requirement specifications

ID	Description	Rationale	Quality attribute
ASR-FUNC-01	Data Consumer must be informed about the conditions and terms of use of the retrieved information	PA1.1-REQ-8 PA1.2-REQ-11 PA1.3-REQ-8	Functional Suitability
ASR-FUNC-02	Where the completion of a procedure requires a payment, users are able to pay any fees online through cross-border payment services, including, at a minimum, credit transfers or direct debits as specified in Regulation (EU) No 260/2012 of the European Parliament and of the Council	SDGR-Art.11.1.e EIF-45 PA1.1-REQ-18 PA1.2-REQ-21 PA1.3-REQ-18 PA2.1-BUSINESS-1 PA2.2-BUSINESS-1	Functional Suitability
ASR-FUNC-03	Data Consumer may use the system to send messages to the Data Provider	PA1.1-REQ-15 PA1.2-REQ-18 PA1.3-REQ-15	Functional Suitability
ASR-FUNC-04	Data Provider may provide data services for verification of specific conditions, i.e. DP replies True/False to specific statement.	PA2.1-PULL-1 PA2.2-PULL-1	Functional Suitability
ASR-PERF-01	DP should not unnecessarily delay the process of transmitting the Data to the DC	PA1.NiceToHave	Performance Efficiency
ASR-PERF-02	DP should communicate the expected level of service associated with the processing of the request for Data from the DC	EIF-19	Performance Efficiency
ASR-IOP-01	Data Consumer must be able to request Evidence about the User from Data Provider	SDGR.Art12.4 SDGR.Art12.2 PA1.1-REQ4 PA1.2-REQ-4 PA1.2-REQ-5 PA1.3-REQ-4	Compatibility Interoperability
ASR-IOP-02	Data Provider must be able to automatically process request for Evidence from Data Consumer	SDGR-Art12.2 PA1.1-REQ-7 PA1.2-REQ-9 PA1.2-REQ-10 PA1.3-REQ-7	Compatibility Interoperability

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ASR-IOP-03	Data Provider must be able to transmit requested Evidence to Data Consumer	SDGR.Art12.2 PA1.1-REQ4 PA1.2-REQ-4 PA1.2-REQ-5 PA1.3-REQ-4	Compatibility Interoperability
ASR-IOP-04	Data Consumer must be able to unambiguously understand and automatically process Evidence retrieved from Data Provider	SDGR-Art12.2 PA1.1-REQ-9 PA1.2-REQ-12 PA1.3-REQ-9 PA2.1-DATA-2 PA2.2-DATA-2	Compatibility Interoperability
ASR-IOP-05	Data Consumer and Data Provider must be technically able to exchange information	SDGR-Art12.2 PA1.1-REQ-3 PA1.2-REQ-3 PA1.3-REQ-3	Compatibility Interoperability
ASR-COE-01	The Competent Authorities must be able to reuse existing national or EU infrastructure, including the BRIS infrastructure	PA1.1-REQ-19 PA1.2-REQ-22 PA1.3-REQ-19 PA2.1-ARCHITECTURE-1 PA2.2-ARCHITECTURE-1	Compatibility Coexistence
ASR-SEC-01	The transmission of an Evidence from DP to DC must guarantee the confidentiality of the exchanged Evidence	SDGR-Art12.2 PA1.1-REQ-16 PA1.1-REQ-17 PA1.2-REQ-19 PA1.2-REQ-20 PA1.3-REQ-16 PA1.3-REQ-17 PA2.1-SECURITY-3 PA2.2-SECURITY-3	Security
ASR-SEC-02	The transmission of an Evidence from DP to DC must guarantee the integrity of the exchanged Evidence	SDGR-Art12.2 PA1.1-REQ-16 PA1.1-REQ-17 PA1.2-REQ-19 PA1.2-REQ-20 PA1.3-REQ-16 PA1.3-REQ-17	Security

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		PA2.1-SECURITY-3 PA2.2-SECURITY-3	
ASR-SEC-03	DC must be informed about the level of availability of Data provided by DP.	PA1.1-REQ-8 PA1.2-REQ-11 PA1.3-REQ-8	Security
ASR-SEC-04	The Evidence provided by DP must be available according to the legal requirements	EIF-27	Security
ASR-SEC-05	Data Consumer must ensure that the request for Evidence was initiated by the User, unless not legally required	SDGR.Art12.4	Security
ASR-SEC-06	Data Provider is responsible for transmitting the requested Evidence in accordance with the confidentiality and integrity requirements,	SDGR.Art12.4	Security
ASR-SEC-07	DP should not provide the evidence if the request does not conform to the legal requirements of DP	EIF-27	Security
ASR-SEC-08	If Data Provider cannot transmit any evidence, data provider must give reasons for this.	LEG-GA-03	Security
ASR-SEC-09	Appropriate audit and logging measures must be implemented to ensure that any exchange of evidence organised under the OOP can be verified by competent authorities in case of disputes (including the identification of the sending and receiving competent authorities, the time of the exchange, and the integrity/authenticity of the exchanged data itself).	LEG-CTRL-02	Security
ASR-SEC-10	Data Consumer must authenticate the *User* before requesting Evidence from Data Provider when authentication is required	PA1.1-REQ-1 PA1.2-REQ-1 PA1.2-REQ-2 PA1.3-REQ-1	Security
ASR-SEC-11	DC must identify the Data Subject associated with the User.	LEG-CTRL-01 PA1.1-REQ-2 PA1.2-REQ-2	Security
ASR-SEC-12	DP must validate that the User is authorized to retrieve information about the Data Subject	LEG-CTRL-01 PA1.1-REQ-2 PA1.2-REQ-2	Security

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ASR-SEC-13	The participants to the Evidence exchange process must be identified, specifically DC and DP	PA2.1-SECURITY-1 PA2.2-SECURITY-1	Security
ASR-SEC-14	DP must verify that data consumer is an authorized digital public service before transmitting the required Evidence	PA2.1-SECURITY-2 PA2.2-SECURITY-2	Security
ASR-SEC-15	Data Consumer must be able to prove that the User explicitly requested the retrieval of Evidence from the Data Provider	SDGR.Art12.4 PA1.1-REQ-5 PA1.2-REQ-6 PA1.2-REQ-7 PA1.3-REQ-5	Security
ASR-SEC-16	Data Provider must be able to prove the reception of the transmitted Evidence by Data Consumer	PA1.1-REQ-11 PA1.2-REQ-14 PA1.3-REQ-11	Security
ASR-SEC-17	Data Consumer must be able to prove the reception of the Evidence request by Data Provider	PA1.1-REQ-10 PA1.2-REQ-13 PA1.3-REQ-10	Security
ASR-SEC-18	The Evidence transmitted by Data Provider to Data Consumer shall be limited to what has been requested	SDGR.Art12.6 PRINC-17	Security
ASR-SEC-19	The Evidence transmitted by the Data Provider to the Data Consumer shall only be used for the purpose of the procedure for which the evidence was exchanged	SDGR.Art12.6 PRINC-18	Security
ASR-SEC-20	When the consent of the user is necessary to retrieve Evidence from the Data Provider, it shall be obtained in accordance with Regulation (EU) 2016/679 and Regulation (EU) 45/2001	SDGR.Art12.6 PRINC-19	Security
ASR-SEC-21	Data provided by the Data Provider to the Data Consumer may not be provided by the Data Consumer to third parties, *except where third parties are required to achieve the communicated purpose, or unless it has been consented by the User*	LEG-GA-04 PA2.1-LEGAL-2 PA2.2-LEGAL-2 PRINC-18	Security
ASR-REL-01	The level of availability of the exchange process must comply with the legal requirements	EIF-27	Reliability
ASR-USA-01	It must be possible to operate the Evidence exchange process according to various deployment models: component on premise,	EIF-35	Usability

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	service on premise, mutualized and centralized service		
ASR-ACC-05	The legal value and meaning of data should not be altered crossing a national border	PA2.1-DATA-1 PA2.2-DATA-1	Data Accuracy
ASR-CONS-01	The User has the possibility to preview the evidence to be used by the Data Consumer and to check the validity of the retrieved information	SDGR-Art12.2 PA1.1-REQ-6 PA1.2-REQ-8 PA1.3-REQ-6	Data Consistency
ASR-COMP-01	The User may be able to add information not provided by the data provider(s)	PA1.1-REQ-13 PA1.3-REQ-13	Data Completeness
ASR-CRED-01	The authenticity of the data transmitted by DP must be trusted by DC	EIF-37	Data Credibility
ASR-CURR-01	Data Consumer can subscribe to change events associated with the Data life cycle	PA2.1-PUSH-4 PA2.2-PUSH-4	Data Currentness
ASR-CURR-02	Modification of data are asynchronously notified, on a predefined schedule, to the Data Consumer that have subscribed to the notification service. A Data consumer has the possibility to unsubscribe to the notification service	PA2.1-PUSH-1 PA2.1-PUSH-2 PA2.1-PUSH-3 PA2.2-PUSH-1 PA2.2-PUSH-2 PA2.2-PUSH-3	Data Currentness

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3. TOOP Reference Architecture

This chapter provides a short summary of the TOOP Reference Architecture. The main version of the architecture with detailed diagrams and explanations is available on the TOOP D2.3 documentation space in Confluence (please see the Glossary).

3.1. Architecture Description

The architecture is described along the business, information system and technology dimensions. It is complemented with specific views addressing cross-cutting quality concerns, such as Security Architecture and Trust Architecture.

3.1.1. Business Architecture

The business architecture is first addressed from the information processing viewpoint[9]. Figure 7 specifies the operational end-to-end processes of executing Once Only Principle as part of the delivery of a public eService. The business process is designed to meet the business requirements.

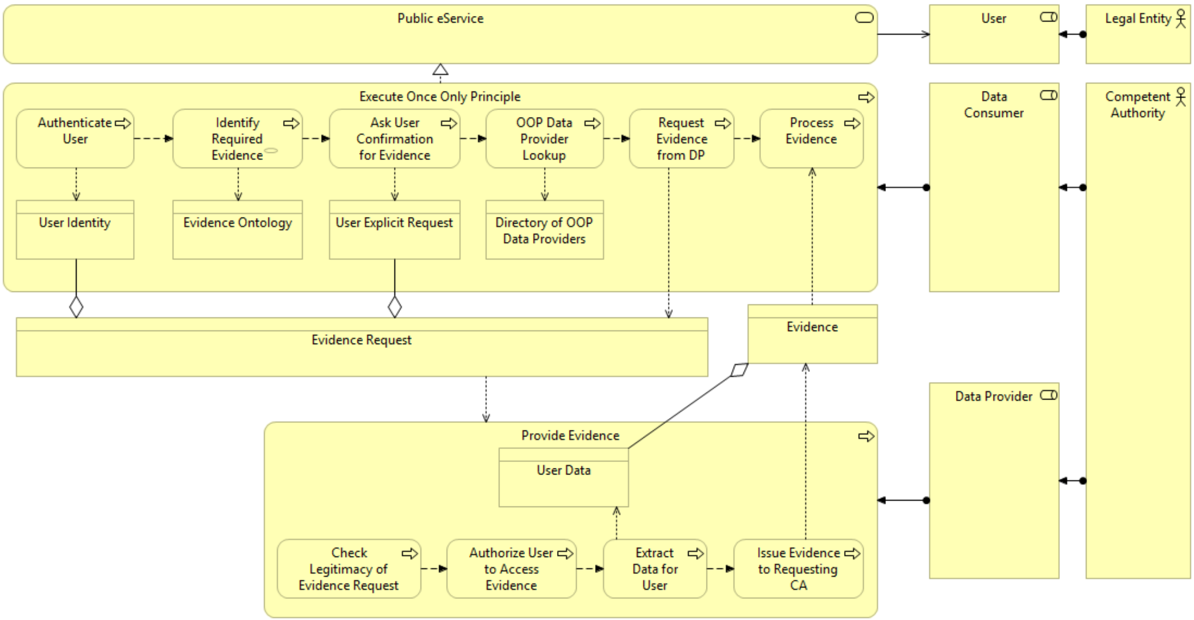

Figure 7: End-to-end Business Process

In Figure 8, a capability map is depicted, which represents the responsibilities of each business role involved in TOOP in terms of required business capabilities. It generically should be interpreted the following way: to participate in TOOP in the role of a Business Role, an organisation is required to deploy the Business Capabilities assigned to that business role.

[9] http://wiki.ds.unipi.gr/display/TOOPRA/Business+Architecture

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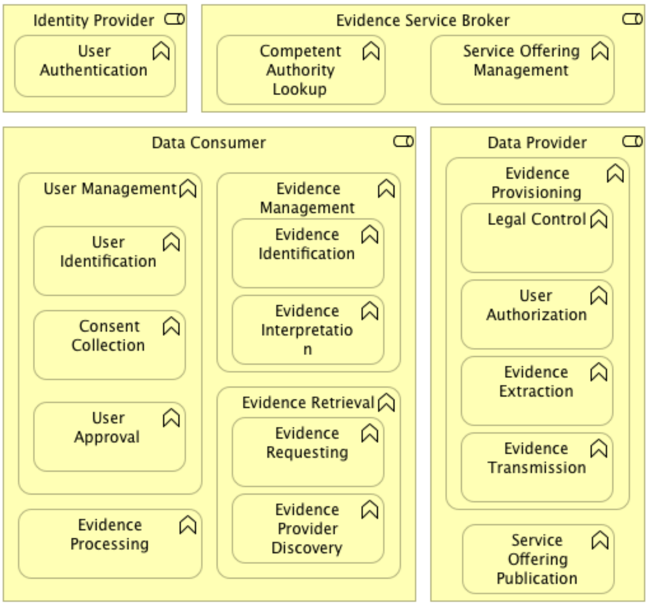

Figure 8: Capability Map

The Capability Map enables the participants to efficiently and easily identify the required business capabilities associated with the role they will play. It is also a valuable tool for architects and designers to support gap analysis when transitioning to TOOP.

Figure 9 specifies the Exchange of Business Information between the various roles participating in TOOP. It generically should be interpreted the following way: as part of a Business Capability deployed by a Business Role, an Exchange of Business Information takes place with another Business Role.

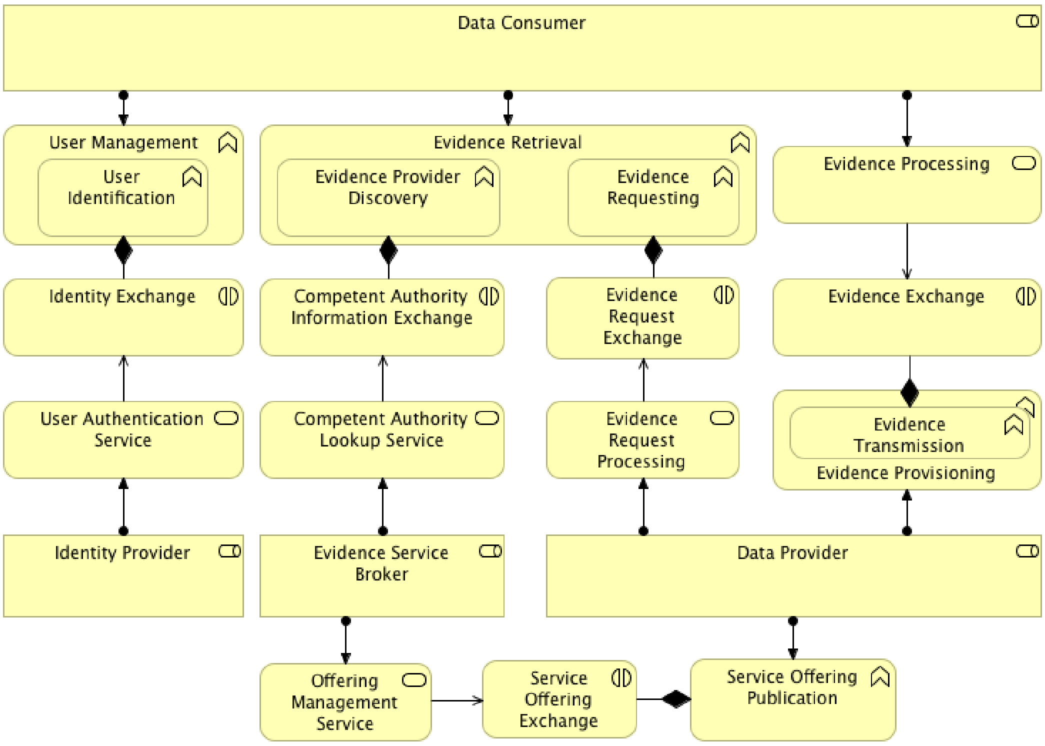

Figure 9: Exchange of Business Information

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The Business Interactions diagram enables architects and designers to efficiently and easily identify the major organisational interoperability points, as each Exchange of Business Information requires to be addressed from an IOP perspective. In TOOP there are 4 main exchanges of business information:

- Identity Exchange, between Data Consumer and Identity Provider
- Competent Authority Information Exchange, between Data Consumer and Evidence Service Broker
- Evidence Request Exchange, between Data Consumer and Data Provider
- Evidence Exchange, between Data Provider and Data Consumer

3.1.2. Information System Architecture

The IS Architecture realizes the business capabilities through the use of application components and functionalities[10].

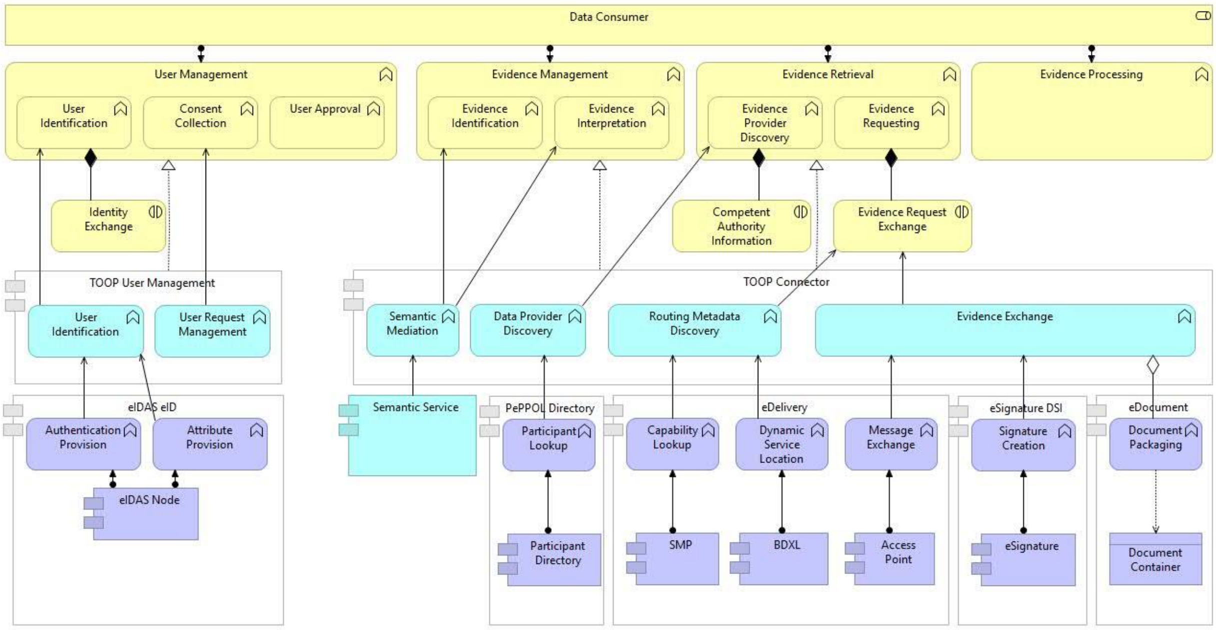

Figure 10 specifies how each DC operational capabilities are realized. The solution introduces 2 main components, encapsulating application functionalities:

- TOOP User Management component, responsible for all functionalities required to support user management in TOOP;
- TOOP Connector component, responsible for all functionalities required to actually exchange Evidence in TOOP.

[10] http://wiki.ds.unipi.gr/display/TOOPRA/IS+Architecture

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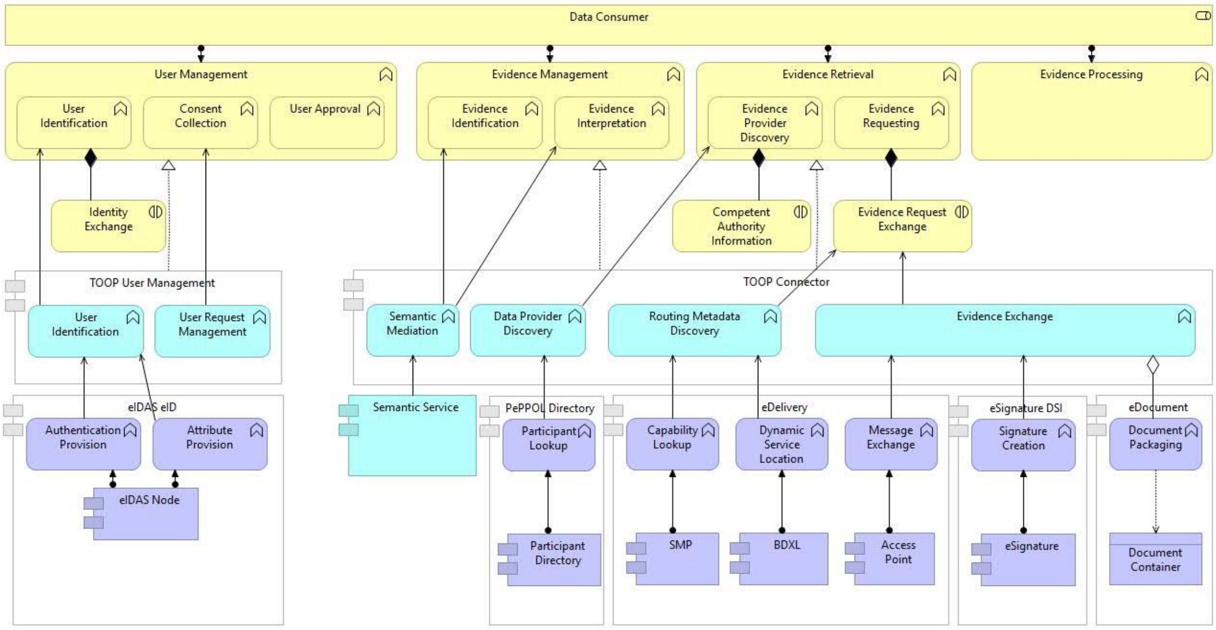

Figure 10: DC Operational Capabilities Realization

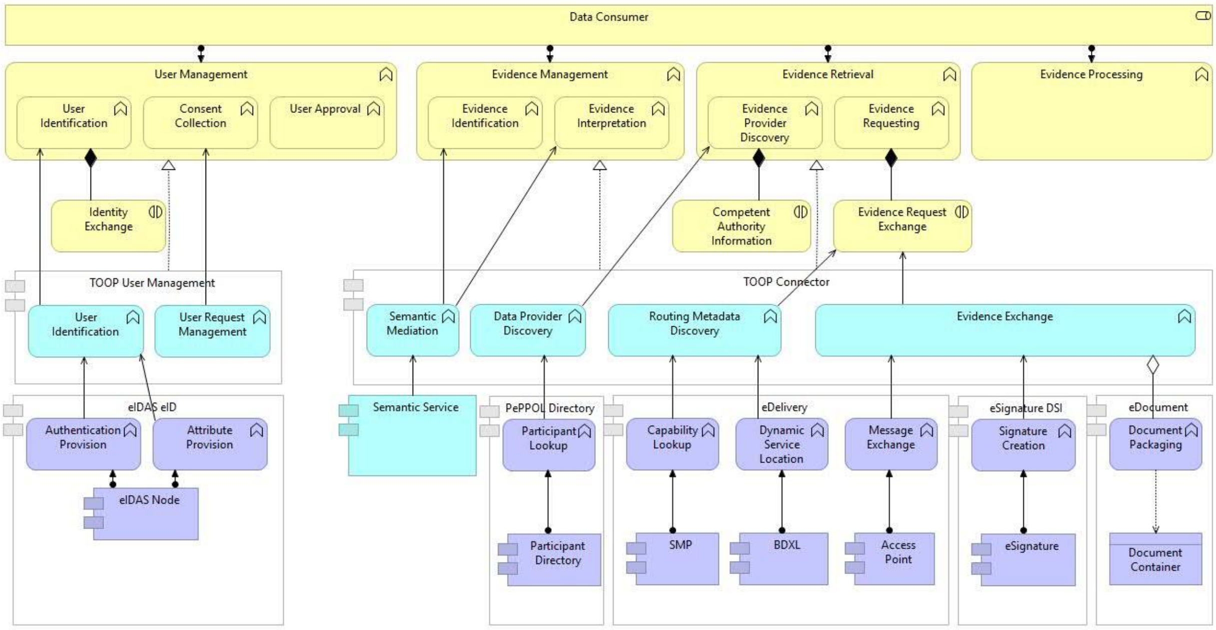

Figure 10 also specifies how the existing Building Blocks are leveraged to realize the required functionalities.

Figure 11 specifies how each DP operational capabilities are realized. The solution introduces the 2 main TOOP components, i.e. TOOP Connector and TOOP User Management.

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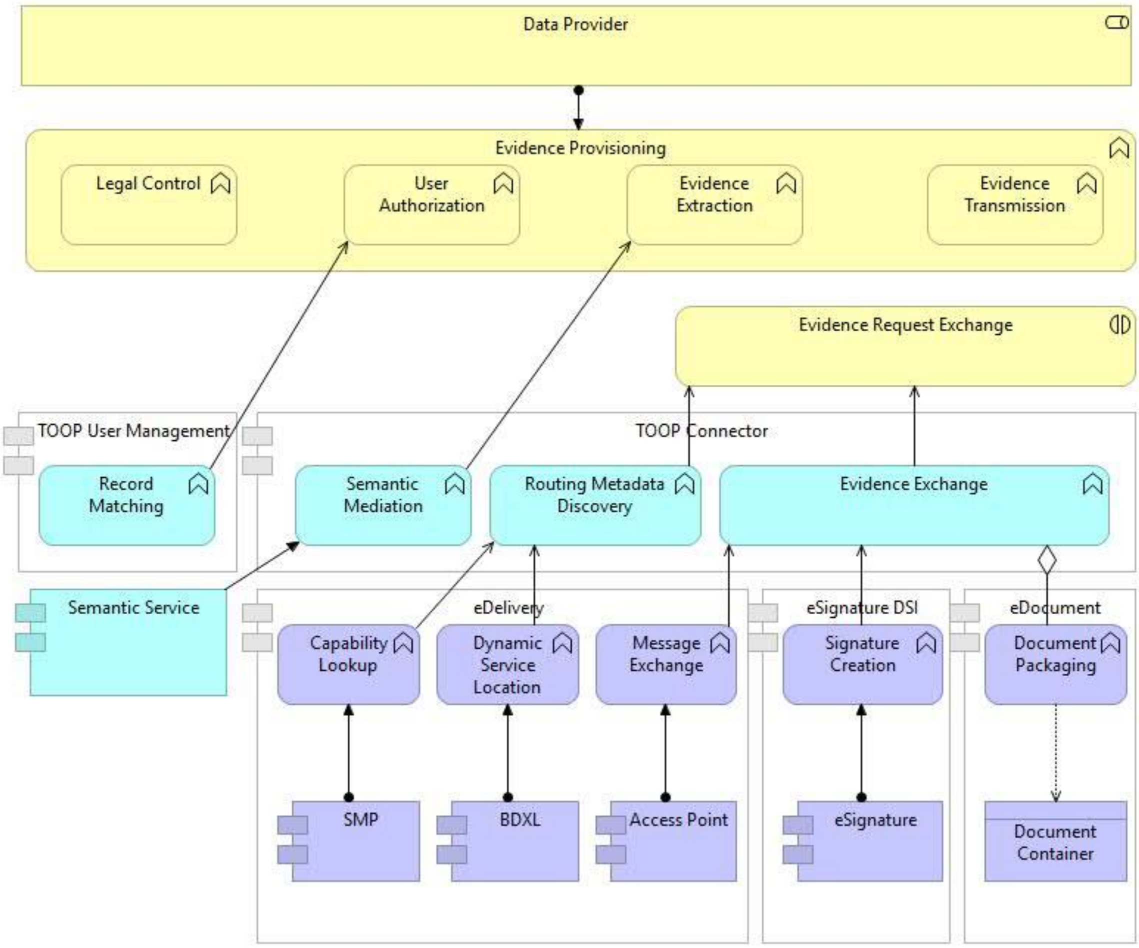

Figure 11: DP Operational Capabilities Realization

3.1.3. Technology Architecture

The Technology Architecture provides logical components and services that are required to support the deployment of business capabilities and application components described in the Information System Architecture[11]. It comprises both the European infrastructure components and the components within the MS responsibility. The components within the MS responsibility include the components maintained by the Member State and by its Competent Authorities.

TOOPRA is a reference architecture and therefore does not directly specify the deployment model. The current TOOP Technology Architecture model is available on the TOOP D2.3 documentation space in Confluence. It comprises two components:

- the Deployment Topologies view,
- the Network and Communication view.

Due to a wide variety of information systems that can be developed using the Technology Architecture, there is no fixed way of how to deploy TOOP services. In the Deployment Topologies view, three different deployment topologies are presented. The impact of different topologies on the business organization and governance is analysed with each deployment option. Each deployment topology

[11] http://wiki.ds.unipi.gr/display/TOOPRA/Technology+Architecture

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comprises the central European infrastructure components, components deployed on the Member State level, and components deployed on a Competent Authority level.

The Network and Communication view focuses on how the system is implemented from the perspective of the communications engineer. It helps to assure that within the system, appropriate communications and networking services are developed and deployed by relevant stakeholders. From the Network and Communication perspective, a TOOP application uses the following components: communication networks in the Member States, TOOP central communications infrastructure, the eIDAS network[12], and the Internet.

The standards/protocols to be used are presented in the Information System Architecture view.

3.1.4. Cross-Cutting Concerns

The TOOP Reference Architecture Cross-Cutting Concerns comprise security architecture, trust architecture, and management aspects[13].

Information security and trust are overlapping, but not identical. The standard ISO/IEC 27000:2016 defines information security as preservation of confidentiality, integrity and availability of information; in addition, other properties, such as authenticity, trustworthiness, accountability, non-repudiation, traceability, and reliability can be involved.

Trust establishment guarantees, that the origin and the destination of the data and documents are authentic (authenticity) and trustworthy (trustworthiness), and that data and documents are secured against any modification by untrusted parties (integrity) (Cofta 2007; Gaurav, Sarfaraz, and Singh 2014; Winslett 2003). Additional constituents of trust management - accountability, non-repudiation, traceability, and confidentiality as a component of trust management - can be supported by maintaining processing logs and other controls, encrypting data and documents during the transmission, etc.

The TOOP security architecture is based on the ISO/IEC 27000-series of standards. Based on ISO/IEC 27000:2016, the Security Architecture section of the TOOP D2.3 documentation space in Confluence proposes the notion of an Information Security Management System (ISMS), consisting of the policies, procedures, guidelines, and associated resources and activities, collectively managed by an organization to protect its information assets. It describes the following steps needed to establish, monitor, maintain, and improve an ISMS:

- identify information assets;
- identify associated information security requirements;
- assess and treat information security risks;
- select and implement relevant controls to manage unacceptable risks;
- monitor, maintain and improve the effectiveness of ISMS.

The Trust Architecture section of the TOOP D2.3 documentation space in Confluence proposes similar steps with regard to trust establishment.

The Management Aspects concern two issues: governance of TOOPRA shared resources and principles of OOP project development. The shared resources include the central European infrastructure components providing the TOOP network management. The governance model of these resources will be provided by TOOP Task 2.5 Sustainability and Governance in its deliverable D2.13 Sustainability aspects of OOP. In the Management Aspects section, the second aspect - principles of OOP project

[12] https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/2018/01/15/EU+Login+Authentication+System+Connected+to+the+eIDAS+Network

[13] http://wiki.ds.unipi.gr/display/TOOPRA/Cross-Cutting+Concerns

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development - is presented. It includes prerequisites and technical development activities of an OOP project.

3.2.Architecture Repository and the D2.3 wiki component

TOOP Reference Architecture is maintained in an architecture repository, which describes each architecture element in detail. The architecture repository can be accessed at http://wiki.ds.unipi.gr/display/TOOPRA. The structure of the repository is aligned with the architecture framework.

The architecture repository also represents the D2.3 wiki component in Confluence.

3.3.Architecture Models

According to ISO 42010, the views of TOOPRA are specified by models expressed in ArchiMate. The architecture models are maintained in a git repository at https://github.com/TOOP4EU/toop-goopra-models. The link to the repository is provided for information only, the repository itself is not part of the current deliverable.

The diagrams presented in this report and on the wiki are extracted from the models in the repository.

Most technical level diagrams of TOOP Reference Architecture use the default iconography of the ArchiMate language[14].

[14] http://pubs.opengroup.org/architecture/archimate3-doc/apdxa.html#_Toc489946151

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4. Architecture Life Cycle Management

A set of Life Cycle management (LCM) processes has been defined, with the aim of providing simplified processes, a better support to stakeholders (including the CEF), fostering user adoption and transparency to the change management of TOOP Reference Architecture. The processes were designed in the spirit of ISO 20000, as a set of IT services provided to a customer. In this case, the customers are the stakeholders of TOOP Reference Architecture.

Independently of how the project receivers will manage TOOPRA life cycle after the hand-over, these IT services have been structured in a generic way and implemented in the JIRA platform, which will facilitate the transfer of support history and open issues to the CEF and other stakeholders.

4.1.1. Life Cycle Management Process

LCM services

The following IT LCM services are provided to TOOPRA LCM:

Table 4: LCM services

Service name	Meme
Support management	'Please perform this with the reference architecture
Change management	'I'd like a new feature to be added in the reference architecture'
Release management	'When will changes be accepted and available?'

Service design

The service design is summarized in Table 5.

Table 5: Service design

Service	Internal outcomes	Customer outcomes
Support Management	Task (work)	Report, info
Change management	Risk assessment, source code, deployable binary	Change acceptance/rejection
Release Management	Release plan	TOOPRA updated, release notes

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Service architecture

The service architecture can be summarized as per the figure below:

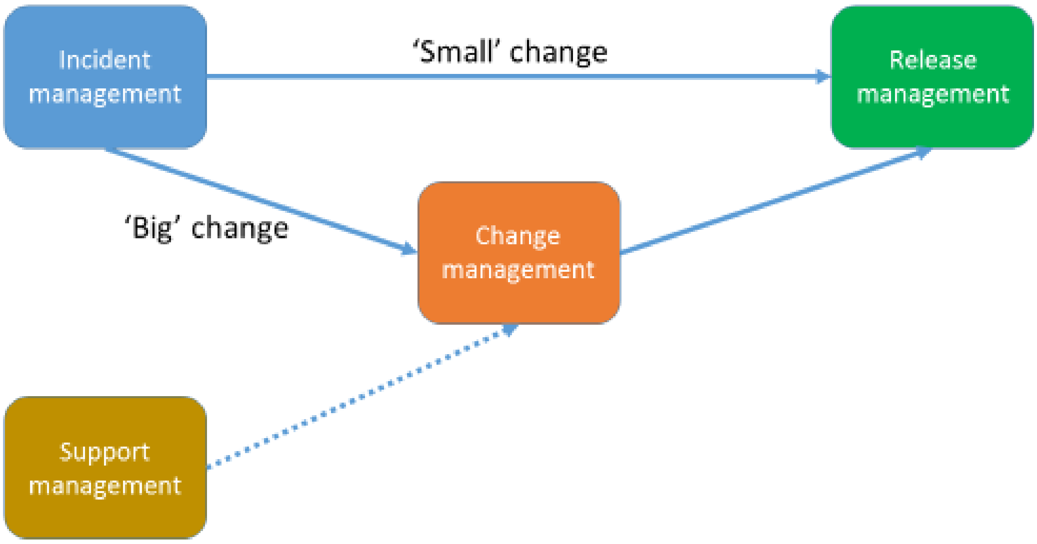

Figure 12: Service Architecture

Service strategy

The service strategy adopted is:

- Ticket/process based (JIRA)
- Make it easy to track progress and effort, consolidate PM's
- Keep it simple towards the customer, however
- Try to get 90% of info from the 1st interaction
- Simple workflows: only customer added-value activities
- CAB (Change Advisory Board) can support the Lead Architect with risk assessment and recommendations

To simplify the service implementation, the Release Management process is embedded in both Incident Management and Change Management processes, providing full history and transparency of changes (issue-to-production).

TOOPRA issues as per Table 6 are reported and tracked on the JIRA platform provided by TOOP partner University of Piraeus.

Table 6: JIRA Projects

Item	JIRA link
TOOPRA	http://jira.ds.unipi.gr/projects/TOOPRA/

4.1.2. TOOPRA Life cycle management

Change management process

The overall process for TOOPRA support includes the Lead Architect dispatching new opened issues to WP2 technical experts, which will do risk assessment and recommendation on change acceptance/rejection. The Architecture Board can be involved as Change Advisory Board (CAB) for complex changes. Typically, the experts discuss the matter as appropriate in JIRA itself and in case of

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favourable opinion propose a change by editing private, next-release document pages in the TOOPRA Wiki[15]. The Lead Architect then picks up the ticket and continues through the embedded Release Management process.

Each ticket in TOOPRA JIRA is cross-linked to the corresponding page in the TOOPRA Confluence wiki, providing full history of changes and ease of navigation between the two platforms. The ticket also features a specific field to signal if public consultation is warranted. This is particularly useful to address issues that imply changes to existing standards used in TOOP, e.g. ETSI, providing full transparency.

Figure 13 depicts the Change Management workflow. On the lower left corner, there is the complementing state-machine.

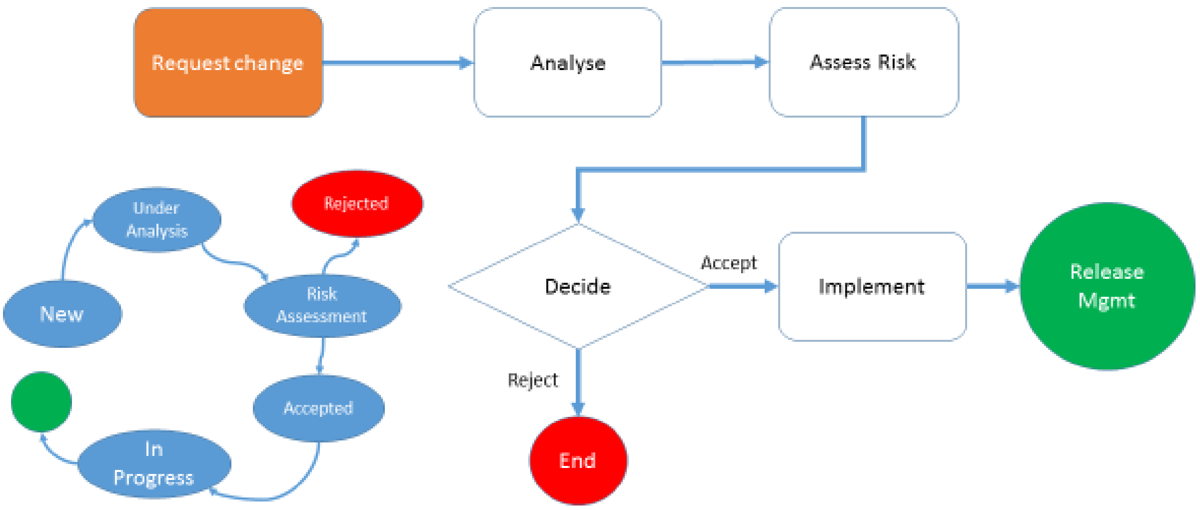

Figure 13: Change Management Process

Release management process

After the acceptance of a change request the Lead Architect eventually communicates the release plan to stakeholders, in the form of release notes for each regular release (e.g., monthly). For accepted changes, the process is closed when the changes are reflected in some published version of TOOPRA wiki.

By connecting JIRA and Confluence platforms, it is possible to relate tickets in JIRA to specific TOOPRA releases, whose content and versioning is managed in Confluence.

Figure 14 depicts the Release Management process workflow. By embedding this process in Change Management, no further JIRA workflow is needed. The embedding translates into adding three more states in the end of IM and CM issues/tickets.

Figure 14: Release Management Process

[15] http://wiki.ds.unipi.gr/display/TOOPRA/

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Support management process

This process was designed to be very generic, to provide architecture support besides change requests.

Basically, the Lead Architect distributes the support request tickets to technical experts, who are expected to document discussions with the requester, peers, external organizations, etc. and ultimately fulfil the request.

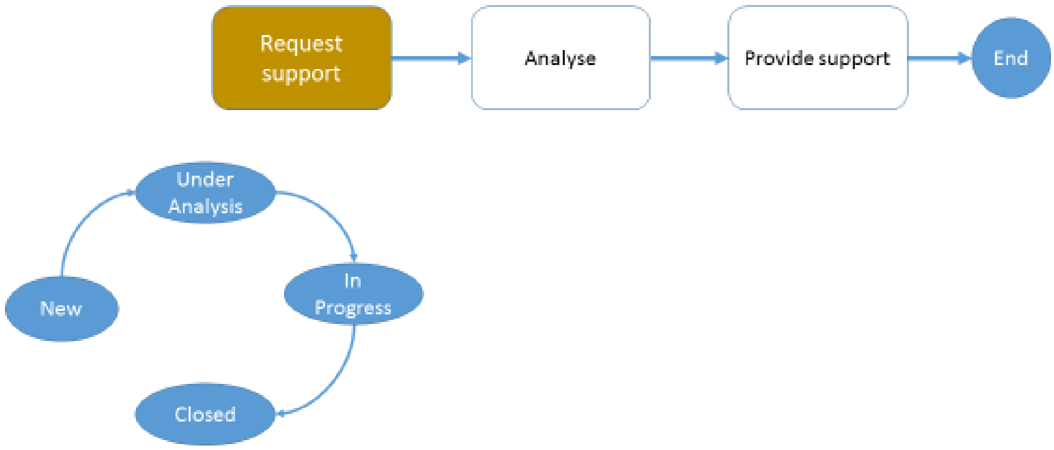

Figure 15: Support Management Process

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5. Alignment and Cooperation with EC Initiatives

Besides the internal collaborations, TOOP Architecture team seeks to align and cooperate with other relevant EC Initiatives. This section summarizes the state of the cooperation.

5.1.EIRA

The TOOP Architecture team followed a one-day workshop by Raul Abril, which took place on 1 June 2018, to better understand the ins and outs of the European Interoperability Reference Architecture (EIRA).

The main result of the workshop was that EIRA and TOOPRA can coexist, as they complement each other. The primary concern of EIRA is to support interoperability of public services at an EU level, while TOOPRA is focused on supporting the OOP in cross-border exchange of documents and evidences. Synergies between the two architectures are evident, since they address different concerns of the same stakeholders. Public services can benefit from cross-border interoperability and from the application of the OOP.

5.2.Power and Mandates

Action 2016.12 of the ISA programme aims at creating a shared European data model for a cross-border interoperable representation of powers and mandates information. This representation will allow the seamless exchange of information about the powers and mandates of natural person when representing a legal person in the context of an eID exchange process.

Currently there is no shared European taxonomy about representation powers and mandates and this fact prevents powers/mandates information originated in one country from being directly machine processable in other. The TOOP project has proposed semantic mediation as a stop-a-gap measure for semantic interoperability in the exchange of this business information, but the development of an ontology for powers and mandates can streamline the overall process of identification and release of consent in TOOP transactions.

TOOP is a Stakeholder for this ISA action and an alignment meeting with ISA has been held in June 2018 in Brussels. TOOP can provide a valuable input to ISA and test the results of this action in the context of the Pilots. From an architecture point of view, the results of the Power and Mandates should integrate the Core Person and Core Business vocabularies with a common taxonomy for representation powers/mandates linked to legal entities, as these vocabularies are already part of the Core TOOP semantic model.

5.3.Access to Base Registries

A synergy and an alignment between TOOPRA and the ISA Action for Access to Base Registries (ABR) is desirable. Up to now some members of the TOOP architecture team and the CCTF have participated in the ABR seminars organized by ISA/Everis.

Base registries are part of the EIF conceptual model for integrated public services provision (source: Annex to EIF COM(2017) 134 final, Part 4). The conceptual model lays a basis for interoperability by design of European public services. To be interoperable, they should be designed in accordance with the proposed model.

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According to EIF, a base registry is *"a trusted and authoritative source of information under the management of some organization which can and should be digitally reused by others. Base registries are reliable sources of basic information on data items such as people, companies, vehicles, licences, buildings, locations and roads. This type of information constitutes the 'master data' for public administrations and European public service delivery. 'Authoritative' here means that a base registry is considered to be the 'source' of information, i.e. it shows the correct status, is up-to-date and is of the highest possible quality and integrity"*[16].

Based on this definition, Base Registries are a basic component of TOOP environment, even if their inner structure is not part of TOOPRA. In some sense, TOOPRA should represent the main model for a base registry framework in compliance to EIF, describing *"the agreements and infrastructure for operating base registries and the relationships with other entities"*.

The following table reports the technical recommendations applicable to Base registries, as listed in the EIF Annex, part 4.

Table 7: EIF technical recommendations applicable to base registries

	EIF recommendation
Recommendation 37:	Make authoritative sources of information available to others while implementing access and control mechanisms to ensure security and privacy in accordance with the relevant legislation.
Recommendation 38:	Develop interfaces with base registries and authoritative sources of information, publish the semantic and technical means and documentation needed for others to connect and reuse available information.
Recommendation 39:	Match each base registry with appropriate metadata including the description of its content, service assurance and responsibilities, the type of master data it keeps, conditions of access and the relevant licences, terminology, a glossary, and information about any master data it uses from other base registries.
Recommendation 40:	Create and follow data quality assurance plans for base registries and related master data.

The ISA ABR action (Access to Base Registries) is aimed at assessing the needs for a Framework for Base Registry Access, based on best practices and all the different activities associated with master data management. One of their objectives is to create a base registry framework that 'describes the agreements and infrastructure for operating base registries and the relationships with other entities', as specified in the new version of the EIF.

Up to now, this action produced an overview of reusable solutions from EU countries in order to facilitate the interconnection and access to base registries, a factsheet of the state-of-affairs in the EU countries, as well as the EFTA countries has also been performed, covering both the individual base registry level, as well as the interconnection level and a series of webinars for the exchange and promotion of best practices among EU countries that aim at speeding up the development and overcoming problems that are being faced by developers.

[16] https://ec.europa.eu/isa2/sites/isa/files/eif_brochure_final.pdf

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As part of the action, they developed guidelines for public administrations, to make the base registries more accessible and efficiently connected, giving them the status of authentic source of data also in a cross-border exchange of information. The guidelines include recommendations and how-to on all interoperability aspects concerning base registries.

5.4.Catalogue of Services

The ISA action about the catalogue of services is aimed at defining a set of tools to create and manage machine-readable descriptions of public services. These descriptions should facilitate the discovery and fruition of services within and across national borders.

The catalogue of services is based on the Core Public Service Vocabulary Application Profile (CPSV-AP), which is a data model for harmonising the way public services are described on eGovernment portals.

Currently the service discovery in TOOP is based on the SML-SMP building block – a synergy between the two initiatives can benefit both parties.

5.5.SDG Common Architecture

The aim of this action is to provide the technical basis for the implementation of the future Single Digital Gateway Regulation[17]. The expected stakeholders of the action are Member States authorities (national, regional, local levels). The TOOP Reference Architecture deliverables are reviewed by the Beneficiary Managers of participating Member States which may potentially create synergies between the TOOP project and the SDG Common Architecture action.

5.6.CEF

The TOOP Architecture team has had several joint workshops involving CEF representatives. The TOOP Reference Architecture makes wide use of the main CEF Building Blocks[18].

[17] https://ec.europa.eu/isa2/actions/common-architecture-single-digital-gateway_en

[18] http://wiki.ds.unipi.gr/display/TOOPRA/.IS+Architecture+v2.3

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Conclusion and future actions

The current deliverable is the third official version of the generic federated Once-Only Principle (OOP) architecture. It develops further the previous architecture deliverable versions D2.1 and D2.2, providing the Business Architecture, Information System Architecture, and Technology Architecture views complemented with views addressing cross-cutting quality concerns, such as Security Architecture and Trust Architecture. The goal model, target users and use cases, as well as presentation of the main stakeholders describe driving forces behind the architecture. The requirements analysis comprises the Architecture Principles and Architecturally Significant Requirements. A set of the TOOP Reference Architecture life cycle management processes and the state of the cooperation of the TOOP Architecture team with other relevant EC Initiatives are provided.

The architecture is aligned with existing EU frameworks (EIRA, EIF), the Connecting Europe Facility (CEF) Digital Service Infrastructures (DSIs), and the building blocks consolidated by the e-SENS project.

The architecture contributes to implementing OOP in public administrations, supports the interconnection and interoperability of national registries at the EU level, and aims to contribute to the implementation act of the forthcoming regulation about the Single Digital Gateway (SDGR).

The deliverable comprises the textual component and the wiki component. The current document is the textual component of D2.3. The wiki component is an architecture repository providing an in-depth content on the architecture views.

This deliverable is a work in progress. The next official deliverable related to the generic federated OOP architecture is D2.4 (M30, June 2019), which will introduce additions to and improvements of this deliverable including:

- Manage requirements traceability on wiki. This includes a mapping between the requirements and the architecture views and components.
- Align the TOOP architecture with the needs and requirements that come from PA3: Maritime Pilot.
- Describe the main interfaces among the architecture building blocks and the way they communicate.
- Describe the standards and protocols to be used at the Technology Architecture.
- Elaborate the role of semantics in the TOOP architecture by defining the functionality and complementarity of “Semantic Mediation” and “Semantic Service” components.

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