D2.1 Architecture Framework

Document Identification			
Status	Final	**Due Date**	31/03/2020
Version	1.4	**Submission Date**	01/04/2020

Related WP	WP2	**Document Reference**	D2.1
Related Deliverable(s)	D2.4, D2.5	**Dissemination Level (*)**	PU
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Keywords :
Metamodel, Once Only Interaction Pattern, Architecture Principles, Framework

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Document History			
Version	Date	Change editors	Changes
0.0.1	14/02/2020	Alexander Bielowski (MinBZK/ICTU)	First draft of the TOC
0.0.2	18/02/2020	Alexander Bielowski (MinBZK/ICTU)	Refinement of TOC
0.1	20/02/2020	Alexander Bielowski (MinBZK/ICTU)	Completion of TOC draft (ready for review)
0.1.1	20/02/2020	Alexander Bielowski (MinBZK/ICTU)	Adapted existing text for 5
0.1.2	21/02/2020	Alexander Bielowski (MinBZK/ICTU)	Addition of 5.6
0.1.3	24/02/2020	Alexander Bielowski (MinBZK/ICTU)	Addition of 6
0.1.4	25/02/2020	Alexander Bielowski (MinBZK/ICTU)	Collection of Principles in 7, addition of chapter 2 and 3 to the TOC
0.1.4	28/02/2020	Harold Meselaar (MinBZK/ICTU)	Review comments
0.1.4	02/03/2020	Alberto Crespo (ATOS)	Review comments
0.1.5	04/03/2020	Alexander Bielowski (MinBZK/ICTU)	Bullet point outline of chapter 3
0.1.6	04/03/2020	Harold Meselaar (MinBZK/ICTU)	Expanded chapter 3, populated list of acronyms
0.1.7	06/03/2020	Harold Meselaar (MinBZK/ICTU)	Reworked Ch3, added communication patterns, types of services and security principles
0.1.8	10/03/2020	Alexander Bielowski (MinBZK/ICTU)	Reworked and extended Metamodel 0 to 4.3.2.8
0.1.9	11/03/2020	Alexander Bielowski (MinBZK/ICTU)	Completed chapter 4.3.3 and 4.3.4
0.1.10	12-03-2020	Harold Meselaar (MinBZK/ICTU)	Added Archi diagrams Viewpoints and text OOP Interaction Patterns
0.2	12/03/2020	Alexander Bielowski (MinBZK/ICTU)	Final edit chapter 3 except 3.7 Completed Chapter 4.3.5 and 6 List of Acronyms Some review comments included

			Marked work in progress yellow
0.2.1	13/3/2020	Harold Metselaar (MinBZK/ICTU)	Populated section on ADM req. mgt. Worked on Interaction Patterns Added photo of BPMN sketch
0.2.2	13/03/2020	Alberto Crespo (ATOS)	Extension of Chapter 2
0.2.3	13/03/2020	Alexander Bielowski (MinBZK/ICTU)	Completion of Chapter 2 Extension of Reference table Completion of Chapter
0.2.4	14/03/2020	Harold Metselaar (MinBZK/ICTU)	Added Chapter 21 Introduction Editorial, spell checker, typos etc. Replaced Whiteboard scans with images for OO-IP
0.3	15/03/2020	Alexander Bielowski (MinBZK/ICTU)	Small revision of chapter 1 Revision of chapter 7 Addition of 8.7 Completion of 9 Conclusions
0.3.1	15/03/2020	Gérard Soisson (CTIE)	Addition of 7
0.3.2	16/03/2020	Harold Metselaar (MinBZK/ICTU)	Review and polishing of Chapters 8 and 9
0.3.3	16/03/2020	Alexander Bielowski (MinBZK/ICTU)	Inclusion of Figure 4 Overall read-through
0.3.4	16/03/2020	Gérard Soisson (CTIE)	Completion of Chapter 7
0.3.5	16/03/2020	Alexander Bielowski (MinBZK/ICTU)	Final ready-through Rephrasing 6.2 and 6.3
0.3.6	16/03/2020	Harold Metselaar (MinBZK/ICTU)	Review Chapter 7, fixed typos Finalized Chapter 1 Review of sections 6.2 and 6.3
0.9	16/03/2020	Alexander Bielowski (MinBZK/ICTU)	Version Ready for internal Review
0.9.1	24/03/2020	Alberto Crespo (ATOS)	Review up to chapter 3
0.9.2	23/03/2020-28/03/2020	Harold Metselaar (MinBZK/ICTU) Gérard Soisson (CTIE) Alexander Bielowski (MinBZK/ICTU)	Incorporating feedback from formal review
0.9.3	26/03/2020	Muhamed Turkanović (UM)	Extension of 8.7
0.9.4	26/03/2020	Alberto Crespo (ATOS)	Review up to chapter 8
0.9.5	28/03/2020-29/03/2020	Alexander Bielowski (MinBZK/ICTU)	Final editorial review
0.9.6	30/03/2020	Alberto Crespo (ATOS)	Review chapter 9 and conclusions
1.0	31/03/2020	Alexander Bielowski (MinBZK/ICTU)	Final version for submission

1.1	31/03/2020	Alexander Bielowski (MinBZK/ICTU)	Some final QA remarks processes
1.2	31/03/2020	Alberto Crespo, Ana Piñuela (ATOS)	Revision of deliverable content
1.3	31/03/2020	ATOS	Quality check for submission
1.4	01/04/2020	ATOS	Final quality check for submission

Quality Control		
Role	Who (Partner short name)	Approval Date
Deliverable leader	Alexander Bielowski (MinBZK)	29/03/2020
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List of Acronyms

Abbreviation / Acronym	Description
ABB	Architecture Building Block
ADM	Architecture Development Method
BB	Building Block
BPMN	Business Process Model and Notation
BPR	Business Process Reengineering
BRIS	Business Register Interconnection System
CEF	Connecting Europe Facility
CFREU	Charter of Fundamental Rights of the European Union (2012/C 326/02)
CPSV-AP	Core Public Service Vocabulary Application Profile
DCAT	Data Catalog Vocabulary
DE4A	Digital Europe for All (this project)
DEP	Digital Europe Programme
DSM	Digital Single Market
EC	European Commission
ECRIS	European Criminal Records Information Exchange System
EESSI	Electronic Exchange of Social Security Information
EIF	European Interoperability Framework
EIRA	European Interoperability Reference Architecture
EUCARIS	the European car and driving licence information system
EUGIP	European Government Interoperability Platform
GDPR	General Data Protection Regulation
ISA2	Interoperability solutions for public administrations, businesses and citizens
LSP	Large Scale Pilot
MS	Member State
N/A	Not Applicable
NRT	Near Real Time
OOP	Once Only Principle
OSI	Open Systems Interconnection model (OSI model)
PSA	Project Start Architecture
SBB	Solution Building Block
SDG	Single Digital Gateway
SDGR	Single Digital Gateway Regulation (REGULATION (EU) 2018/1724)
SSI	Self-Sovereign Identity
TBD	To Be Determined/Defined
TEU	Consolidated versions of the Treaty on European Union and the Treaty on the functioning of the European Union (2008/C 115/01)
TOGAF	The Open Group Architecture Framework
TOOP	The Once Only Principle Project
UML	Unified Modeling Language
WP	Work Package
ZKP	Zero Knowledge Proof

Executive Summary

The architecture framework of the "Digital Europe for All" project (DE4A) provides the methodological foundation for the overall project. In addition, we propose a long-term architecture vision that should guide the development of the Once-Only Technical System to be a significant step towards a more encompassing ecosystem. It is a working document and will be updated with additional insights over the course of the project. Consequently, this first version is not a normative architecture document, but a contribution to the Once-Only Principle discussion in this project and other relevant initiatives, including the Connecting Europe Facility (CEF) preparatory action and the Single Digital Gateway (SDG) implementation. It is also an open invitation for comments and contributions extended beyond DE4A.

The Architecture Process, derived from TOGAF ADM [42] that was implicitly underlying the DE4A description of action, is made explicit in order to guide architecture related work, including the interrelations with and responsibilities of other work packages. Also the proposed Architecture Metamodel, derived from ArchiMate [1], TOGAF [42] EIRA [31] and including BPMN [3], is relevant beyond the DE4A architecture work package (WP2), for example, in defining the solution architecture of the cross-border pilots DE4A will deliver. In this first version it is tailored to the minimum set of elements. However, it might be extended with additional elements if required. This is good practice in order to ensure that the architecture model serves the purpose of the project and avoid unneeded modelling overhead.

The architecture descriptions in DE4A will cover several time horizons. In total, five distinct horizons are identified and numbered 0 to 4. Starting from (0) the current status quo – the baseline – and reaching via (2) the SDG 2023 time horizon to (4) the long-term future vision. Given the current focus on the Once-Only Principle, much of the detailed architecture work and piloting of DE4A will centre around the (2) SDG 2023 time horizon and the (3) mid-term evolution of the Once-Only Technical System.

For the (4) long-term time horizon, a first, high-level draft of the vision of a European Digital Single Market Ecosystem is presented that encompasses all citizens, all businesses, all public administrations (EU, National, Local) and all types of services. We envision a mycelium-like system, consisting of independent, yet seamlessly interconnected organisms that are nurtured through the economic interest of participating authorities and businesses; an ecosystem that is very robust and distributed, sustained solely based on the value-add it provides.

The DE4A Principles are derived from European law and policy documents and structured in fundamental and derived principles, geared towards the mid- to long-term time horizon. They draw a picture of a system that is fully OOP, digital by default and highly inclusive and accessible. Only the required minimum of structured, authentic data is transferred under full control of the user via a federated and largely decentral system while ensuring that the control of and responsibility for the authenticity always remains with the issuing, competent authority. The system -or ecosystem - should be created by reusing existing Solution Building Blocks as much as possible and be based on accepted, international and European standards in a way that it can evolve in the future to include new technologies and be set up in a European and market friendly manner. DE4A plans to document exceptions to these principles that are needed for a first version of the Once-Only Technical System to be implemented today, as the basis for recommendations on how these barriers can be overcome.

Creating an information ecosystem that is able to accommodate the specific requirements of 27 member states in several different domains and can be integrated in the current baseline architecture of all member states can most likely not be based on a single interaction pattern, surely if we also consider the growth of the system to the commercial sector. DE4A envisions a federated multi-pattern architecture and provides in this document a set of 7 charcoal sketches of different interaction

patterns. The next step is to apply the proposed metamodel in detailing these patterns out and aligning them with the pilot requirements in the creation of the DE4A Project Start Architecture (D2.4).

1 Introduction

1.1 Purpose of the document

The present document, D2.1 Architecture Framework, is the main output of the task Architecture Framework of WP2 'Architecture Vision and Framework' for the project DE4A. The Architecture Framework will become an integral part of the DE4A toolbox (D2.6 'Service interoperability solutions toolbox') and will be further refined in subsequent versions. It is important to note that this is an on-going living document in an agile project environment, thus updates are foreseen throughout the DE4A project duration. As such, this first version is not to be considered a normative architecture document, but a contribution to the discussions surrounding the Once- Only Technical System, the Single Digital Gateway (SDG), the Digital Single Market (DSM) and the European Government Interoperability Platform (EUGIP), and, in turn, an invitation to comment and contribute, especially to the principles and vision expressed in this document.

It provides the DE4A project with its architecture context and guidance to realize the cross-border exchange of public services and the required evidence. It will form the basis for producing other WP2 deliverables, such as D2.4 and D2.5 Project Start Architecture (1st and 2nd iteration), D2.6 Service interoperability solutions toolbox, but will also provide architectural guidance to other WPs, such as (but not limited to) WP4 'Cross-border Pilots for Citizens and Business and Evaluation', WP5 'Common Component Design & Development' and WP7 'Legal and ethical compliance and consensus building'.

This document provides a DE4A Principles Catalogue i.e., the architecture principles that will drive the architectural work. Principles are general rules and guidelines that inform and support the way how DE4A sets about fulfilling its mission. They reflect a level of consensus among the various elements of the Digital Single Market and form the basis for making future decisions.

It also proposes a strong architecture process together with a metamodel in order to address the architecture design, the capturing of the architecture and the implementation thereof. The architecture process is based upon TOGAF [42] Architecture Development Method (ADM), but is tailored to DE4A. The metamodel builds on the same basis as the European Interoperability Reference Architecture (EIRA): using TOGAF and ArchiMate, thus providing layers and abstraction levels.

This document is also meant to set out the architecture vision encompassing the current baseline, Your Europe Gateway, the Once-Only Technical System and extending beyond 2025 envisaging a sustainable European Digital Single Market Ecosystem. It defines five time horizons to put the architectural work in context.

An initial first set of Once-Only interaction patterns is proposed. These are concepts that portray and solve some essential cohesive elements of the cross-border exchange of evidence challenge.

1.2 Structure of the document

This document is divided into nine main sections:

- Chapter 1 – The current introduction chapter.
- Chapter 2 – This chapter presents the background of the DE4A activity and puts it in its wider context.
- Chapter 3 – In this section the Architecture Process is explained. It describes the process followed for later development and implementation of the architecture for DE4A.
- Chapter 4 – An extensional architecture metamodel is presented based on EIRA and using TOGAF and ArchiMate. It covers Business, Application and Technology Architecture. Several levels of abstraction are used, i.e. Conceptual/Functional, Logical and Physical.
- Chapter 5 – The Architecture Time Horizons are presented. This chapter puts the activity in the context of time, moving from the Baseline to Your Europe Gateway Version 1 (12.2020), Once-Only

Technical System Version 1 (12.2023) and Once-Only Technical System Version 2 (approx. 2025). The section concludes with looking further ahead to future developments (long- term).

- Chapter 6 – In this section the Long-term Architecture Vision is laid out. A Multi-Pattern Technical Architecture is envisaged with flexibility and extensibility as its main drivers. This chapter also reflects on the Digital Europe for All (DE4A) project and proposes the long-term view of a consistent, sustainable and future-proof European Digital Single Market Ecosystem.
- Chapter 7 – Principles Catalogue. The DE4A principles are based on existing legal provisions of the EU and strategic documents referring to eGovernment and digitalisation. We distinguish between fundamental principles (the why) and derived principles (the how).
- Chapter 8 – Once-Only Interaction Patterns. Providing several OO Interaction Patterns: Intermediation, various flavours of User Managed Access, Subscription and Notification, and Lookup.

  Chapter 9 – Conclusions. This section provides preliminary conclusions and an outlook on future work.

2 Background

The Once-Only Principle (OOP) is a fundamental principle, playing a key role within strategic policy action lines such as the Single Digital Gateway Regulation [37] in support of the Digital Single Market (DSM), the wider European digital agenda and part of the Tallinn Declaration on eGovernment [35]. It is aimed at empowering citizens and businesses, as users of cross-border digital public services eliminating the need to provide the same information more than once. It furthermore makes possible numerous benefits when applied in the context of the Digital Transformation of public services: tangible reduction of administrative burden and costs, more efficient public sector with better quality, user-centric delivery of services related to key life events and increased citizen satisfaction and trust in government.

Over the course of the last years, CEF Digital [4], ISA and ISA^2 [25] have delivered a great number of valuable Building Blocks and Solutions helping public administrations to build interoperability at all levels in a well-structured manner, while at the same time following other fundamental well-established principles in the European Interoperability Framework [16], which is an essential requirement to realize OOP by sharing and re-using relevant data (also across borders) with respect to of applicable data protection rules and regulations. In this regard, we can highlight for their prominence and relevance for DE4A:

- CEF Building Blocks and Digital Service Infrastructures, like eID [14], eDelivery [11] and obviously the CEF OOP Preparatory Action [5], are key for making the future Once-Only Technical System a reality with the support of the Member States and within an already established framework of fruitful collaboration through projects like DE4A. Leveraging the expertise accumulated in the past decade in cross-border electronic identity and trust schemes interoperability through eIDAS, which constitutes a major example of European-level accomplishment, underlines the solid basis we have for addressing the challenges ahead.
- ISA^2 Actions [26] and Solutions represent an invaluable repository of knowledge and technical solutions (almost 2,800 interoperability solutions for public administrations exist in Join up [33]) and guidance on multiple areas: from Semantic Interoperability (SEMIC [38], encompassing common definitions, specifications and tools, e.g. Core Vocabularies [28], ADMS [27], CPSV-AP [29], DCAT-AP [30]), to assessment of interoperability maturity (IMAPS [32]) or continued monitoring of National Interoperability Frameworks and their alignment with the European Interoperability Framework (NIFO [34]) and eLearning interoperability resources (Interoperability Academy [24]).
- The European Interoperability Reference Architecture (EIRA [31]) is a key architecture content metamodel and constitutes a major source of guidance to organize and classify the most salient Architectural Building Blocks.
- DG-GROW includes several relevant Solutions that an OOP system might build on. IMI [23] can be seen as a 'predecessor' of the Once-Only Technical System and can provide valuable lessons learned and other information assets (i.e. list of authorities). eCertis [9] provides a semantic interoperability solution in the area of e-Procurement that could potentially be generalized to a multi-sector solution.

In addition, in the last years, several large-scale pilots and projects have been established, such as STORK [39], STORK 2.0 [40], e-SENS [19], SCOOP4C [36] and TOOP [43], which added valuable experience and solutions to the overall solution space and provided valuable insights into the interoperability of existing building blocks.

We also need to consider sectoral networks and solutions that have been created on the European level over the course of the last years: EESSI [12], BRIS [2], ECRIS [10], EUCARIS [20] or - in higher education - the European Student Card Initiative [21], Erasmus Without Papers Network [18] and EMREX [17].

The Single Digital Gateway Regulation (SDGR) brought the OOP principle up to the level of a legal obligation for a very specific functional scope consisting of 21 procedures defined in Annex II of the regulation and four existing Directives. It has an ambitious implementation timeline with December 2023 as the deadline. Obviously, this is at the moment on everybody's mind in the area of OOP.

Furthermore, there are other changes and initiatives taking place. The Digital Europe Programme (DEP) [8] and the new 2019 Digital Agenda of the new European Commission, together with the discussions in the context of the European Government Interoperability Platform (EUGIP), show that there is a much bigger aspiration in the EU and that OOP in general and SDG (in particular) are only a step towards a more comprising vision of a fully functional, world leading, Digital Single Market.

DE4A builds on all this prior work and contributes to on-going initiatives in the of CEF OOP Preparatory Action and the upcoming OOP Technical System Implementing Act and attempts to do so in a way that takes the long-term vision and perspective fully into account. OOP, as it stands today, is less a question of developing new solutions, than of putting together the existing building blocks in the right way to provide enough flexibility for implementation in 27 national infrastructures and that is at the same time sustainable, market oriented and geared towards the bigger picture. We expect that there are several valid combinations that are required to cover these complex requirements that optimally are compatible with each other.

3 Architecture Process

This chapter describes the process followed for developing and implementing DE4A under Architecture guidance. It integrates elements of TOGAF as well as other available architectural assets, to meet the business and IT needs of DE4A. We adopt the TOGAF Architecture Development Method (ADM), as envisioned during the proposal phase. The ADM describes a method for developing an enterprise architecture and forms the core of TOGAF.

The architecture describes the relevant building blocks of the envisioned systems, their interrelation and the rules and principles that govern these relationships and their evolution over time. The architecture description in DE4A is meant to cover all levels of Enterprise Architecture descriptions: directional (i.e. principles derived from policy needs and legal compliance (cf. WP7 'Legal and ethical compliance and consensus building')), organisation (i.e. actors and processes), application (i.e. application services and components, main data objects) and technology (i.e. nodes, system software). This Enterprise Architecture is clearly not confined to a single organisation but addresses cross-border interoperability aspects involving ultimately many thousands of organisations and information systems.

Please note that, since DE4A is a special case in the sense that it is a pilot project with a focus on learning in addition to operational value creation, this is reflected in our tailoring of the ADM and is explained in the coming sections.

3.1 Introduction

The ADM is a generic method for architecture development, which is designed to deal with most system and organizational requirements. The following are the key points about the ADM:

The ADM is iterative on different levels: over the whole process, between phases, and within phases. For each iteration of the ADM, a fresh decision must be taken as to the breadth of coverage, level of detail, the extent of the time horizon aimed at, including the number and extent of any intermediate time horizons and the architectural assets to be leveraged.

As a generic method, the ADM is intended to be used by enterprises in a wide variety of different geographies and applied in different vertical sectors/industry types. The basic structure of the ADM is shown in Figure 1.

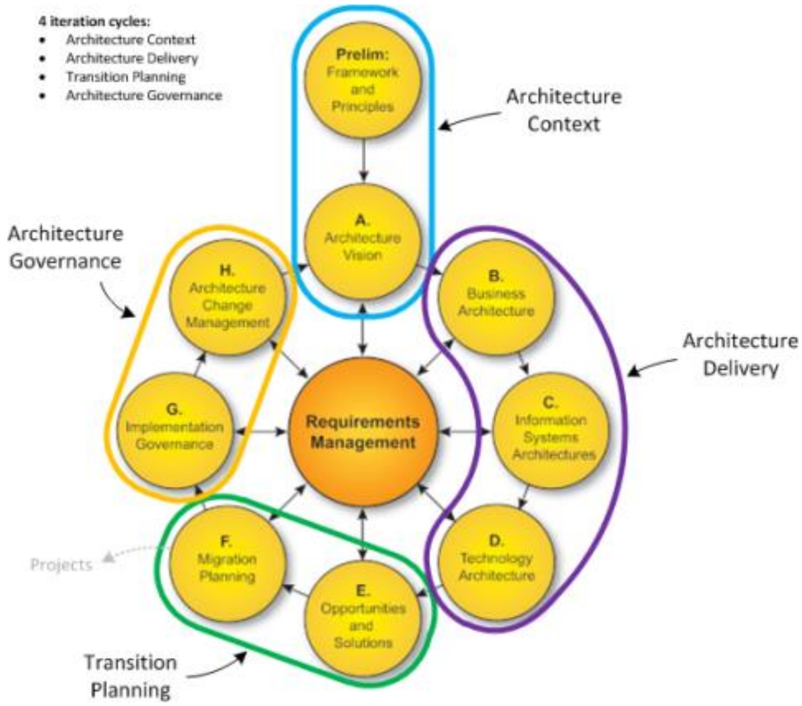

Figure 1: Architecture Development Cycle [42].

The Architecture Development Cycle is often divided into four iteration/life cycles:

1. Architecture Context,
2. Architecture Definition/Delivery,
3. Transition Planning, and
4. Architecture Governance.

These iterations group together the ADM phases (A-H, Figure 1) and are described at high-level in the following sections. In each phase, artefacts (outputs) from the earlier phase may be refined in later phases, for instance, the Architecture Vision is worked on throughout the ADM.

This document is not meant to explain the TOGAF ADM. As such, please refer to the TOGAF Standard for details [42].

3.2 ADM Iterations

DE4A is a pilot project and has a wide scope. On the one hand WP2 provides an architectural baseline for the pilots, while on the other the Architecture vision furthermore extends beyond the pilots. This is reflected in the tailoring of the ADM for DE4A. The following ADM iterations are foreseen and are presented in Table 1.

Table 1 ADM Iterations within DE4A.

Iteration	ADM coverage	Context and main deliverable
1	Full ADM cycle (all phases)	Cross-border Pilots • D2.4: 1st version of the Project Start Architecture (PSA)
2	Architecture delivery (Phases B, C and D only)	Wider scope, Once-Only Technical System Version 2 (see section 5.4 for details).

		• D2.7: Optimal Interoperability Architecture for Crossborder procedures and evidence exchange SDGR.
3	Full ADM cycle (all phases)	Cross-border Pilots, taking on board the lessons learned - Architecture change management. • D2.5: 2nd version of the PSA.
4	Architecture delivery (Phases B, C and D only)	Wider scope, Digital Single Market Ecosystem (see section 5.5 for details). • D2.8 Beyond interoperability: One Network for Europe.

3.3 Architecture Context

The Architecture Context iteration is the core and basis of this WP2 task, which will output the D2.1 in several version throughout the project. The Architecture Context is established by performing two of the ADM phases, i.e. the preliminary phase and the phase A: Architecture vision.

3.3.1 Preliminary Phase

This Preliminary Phase is about defining "how we build an architecture" in DE4A. There are two main aspects: defining the framework to be used and defining the architecture principles that will guide and support any work on the architecture. DE4A's approach to re-use of architecture assets is a key part of both the framework definition and architecture principles.

Key outputs:

- Framework definition: see chapters 4 Architecture Metamodel, 5 Architecture Time Horizons and 8 Once-Only Interaction Patterns
- Architecture principles: see chapter 7 DE4A Principles

3.3.2 Phase A: Architecture Vision

In this phase, an Architecture Vision for DE4A is articulated. The main objective is to develop a high-level aspirational vision of the capabilities and business values to be delivered as a result of the proposed Architecture.

Key outputs:

- Architecture Vision: see chapter 6 Long-term Architecture Vision

This document is the output of the Architecture Context Phase of DE4A.

3.4 Architecture Delivery:

Architecture delivery encompasses ADM phases B (Business architecture), C (Information Systems Architecture) and D (Technology Architecture). The phases share similar goals, objectives, approaches and steps, but each phase focuses on specific architecture domain, i.e., B) Business, C) Information System and D) Technology.

As can be seen from Table 1 ADM Iterations within DE4A., we have essentially four Architecture Delivery iterations. In order of the delivery, these are the following:

1. Architecture Delivery as part of full ADM cycle (iteration 1 in Table 1)

   Key outputs:

   - PSA v1 (Scope: Pilots): D2.4 Project Start Architecture (PSA) first iteration:

  - Baseline (cf. D1.1 Member state eGovernment Baseline, D1.3 Member state Once Only and data strategy Baseline, D1.5 Baseline EU Building Blocks supporting Once-Only and standard data sharing patterns)
  - Generic Architecture/Reference Architecture:
    - Common Services
    - Trust Model
    - Semantic Solution
    - Integration patterns
  - Requirements (Use Cases and requirements: D4.1, D4.5 and D4.9 and Initial requirements for semantic assets: D3.1)
  - Constraints
  - Interaction patterns (Business, Information System and Technology)
  - Principles and exceptions
  - Candidate SBBs [31]

2. Architecture Delivery (iteration 2 in Table 1)

   Key outputs:

   - Target Architecture v1 (Scope of the OO technical system): D2.7 Optimal Interoperability Architecture for cross-border procedures and evidence exchange in light of the Single Digital Gateway Regulation

3. Architecture Delivery as part of full ADM cycle (iteration 3 in Table 1)

   Key outputs:

   - PSA v2 (Scope: Pilot): D2.5 Project Start Architectures (PSA) second iteration
     - Baseline (cf. D1.2 Updated Member state eGovernment Baseline, D1.4 Updated Member state Once Only and data strategy Baseline, D1.6 Updated EU Building Blocks supporting Once Only and standard data sharing patterns)
     - Generic Architecture/Reference Architecture
       - Common Services
       - Trust Model
       - Semantic Solution
       - Integration patterns
     - Requirements (Updated deliverables, lessons learned and output from Architecture Change Management (see section 3.6))
     - Constraints
     - Interaction Patterns (Business, Information System and Technology)
     - Principles and exceptions
     - Candidate SBBs

4. Architecture Delivery (iteration 4 in Table 1)

   Key outputs

   - Target Architecture v2 (Scope Digital Single Market): D2.6 Service interoperability solutions toolbox, D2.8 Beyond interoperability: One Network for Europe (ONE)

Please note that in iterations 1 and 3, the matching between the reference patterns and implementation context (pilot use cases) is done in joint workshops with WP4 'Cross-border Pilots for Citizens and Business and Evaluation', based on insights from D4.1 Studying Abroad – Use cases definition and requirements, D4.5 Doing Business Abroad – Use cases definition and requirements and D4.9 Moving Abroad – Use cases definition and requirements. Iteration 3 (D 2.5) primarily relies on Architecture Change Management (ADM phase H) as input. In addition, D2.2 'Initial DE4A Trust

Management Models and Blockchain Support Framework Design' and D3.3 'Semantic framework Initial version' are also inputs for this.

3.5 Transition Planning

The Transition Planning is performed only for the Pilots in iterations 1 and 3 (see Table 1). The outputs of iterations 2 and 4 are deliverables for external reference, as their implementation is beyond the scope of this project.

Transition Planning constitutes ADM phases E (Opportunities and Solutions) and F (Migration Planning). These phases establish how to effectively implement the Target Architecture identified in previous phases. Transition Planning also addresses migration planning; that is, how to move from the Baseline to the Target Architectures by producing a detailed Implementation and Migration Plan.

Transition Planning is performed together with WP3 'Semantic Interoperability Solutions', WP4 'Cross-border Pilots for Citizens and Business and Evaluation' and WP5 'Common Component Design & Development', culminating in the Pilot Planning Deliverables (D4.2, D4.6 and D4.10). Phase E sets the PSA into the context of a Solution Architecture for each given Pilot that can then run the two or three defined high-level use cases per pilot. Phase F compiles the step- by-step plan of getting the Pilot infrastructure implemented and ready to use, including the acquisition of the pilot population.

Key outputs:

- Implementation & Migration plan (Pilot Planning Deliverables D4.2, D4.6 and D4.10.) and Transition Architectures
- Architecture Requirements

3.6 Architecture Governance

Architecture Governance consists of ADM phases G (Implementation Governance) and H (Architecture Change Management), and it ensures that conformance with the Target Architecture is maintained by implementation projects. Appropriate Architecture Governance functions for the solution and any implementation-driven architecture Change Requests are executed.

For DE4A this will be performed as part of further task, which means that task includes the architectural guidance and oversight of the Pilot implementations. Architecture compliance is executed using a "Comply or explain" approach. The results are recorded in an Architecture Log. This is an internal document that contains the structured documentation of the degree to which Pilot implementations and common component development adhere to the target architecture and to the architecture principles set forward in the Project Start Architecture description, as well as the rationale behind accepted exceptions/waivers. This feeds into the compliance assessment and presents the means to uncover and document barriers to interoperability and these represent valuable inputs for WP6 'Sustainable Impact and new governance models' and WP7 'Legal and ethical compliance and consensus building', in addition to the pilot running phase reports from WP4.

WP4 'Cross-border Pilots for Citizens and Business and Evaluation', WP5 'Common Component Design & Development' and WP3 'Semantic Interoperability Solutions' follow an agile approach. The role of WP2 in this agile working method, cf. ADM Phase G Implementation Governance, is being integrated in the current detailing and implementation of that method across WP3, WP4 and WP5.

It is here, in the Architecture Governance cycle, that the difference between a typical implementation project and a pilot project becomes most apparent. Typically, Implementation Governance tries to keep the implementation as compliant as possible. Waivers can be granted with an agreed date by which the project shall be compliant. Deviations are restricted to a minimum.

In our Pilot project, every deviation is an opportunity to learn, the architecture log, the barriers identified, and the lessons learned - the exceptions that made it work – are equally valuable for the European Commission (EC) and the Member State (MS) as the initial architecture direction.

Naturally, change requests can be expected and any changes to the new architecture must be managed. This will be done on the basis of an internal document "Change Management Process Document" to be agreed between technical work packages (WP2, WP3, WP4, WP5).

What we learn during the first Pilot iteration is transmitted into the Architecture Delivery iteration for - D2.5 Project Start Architectures (PSA) second iteration.

Key outputs:

- Architecture compliant Solutions
- Compliance Assessment
- Change Requests (RFCs)
- Architecture updates
- Changes to architecture framework and principles

3.7 Requirements

Central to the ADM is the Requirements Management process, which is applicable to all relevant ADM phases. In fact, the ADM is continuously driven by the requirements management process. Requirements management, is a dynamic process whereby requirements and subsequent changes to those requirements are identified, stored, and fed into and out of the relevant ADM phases. The requirements will be managed along the five European Interoperability Framework (EIF) interoperability dimensions: Legal, Organisational, Semantic, Technical and Governance. Requirement Management is a shared responsibility by all DE4A work packages (WP).

Input

The inputs to the Requirements Management process are the requirements-related outputs from each ADM phase. The first high-level requirements are produced as part of the Architecture Vision. Deliverables in later ADM phases provide new types of requirements.

Inputs can be categorized as external or internal, depending on the source that generates them:

External requirements:

- Blueprint
- OO Technical System Implementing Act
- EIF/EIRA
- EU Legal Framework, specifically the SDGR [37]
- Standards and Policies

Internal requirements - from all WPs, but especially contributions from (non-limitative):

- WP3 requirements for semantic assets (D3.1, D3.2)
- WP4 Use Case definition and requirements (D4.1, D4.5, D4.9)
  Mainly requirements elicitation in the context of description of the UCs. Workshops, team visits and tele-conferences are used for this purpose.
- WP5 Inventory of features for products/components (D5.1, D5.2)
- WP7 Legal and ethical requirements (D7.1, D7.2, D7.3)

The aforementioned deliverables are taken as inputs to produce the outputs below, considering their respective due dates. This means that, if a deliverable is finalized, it can be used as an input. If the deliverable is not finalized, inputs are addressed by liaising with the WPs in order to take include their requirements.

Process

1. Identify and document requirements
   A unique ID is assigned to each requirement and a naming convention indicates the type of requirement (Functional, Non-functional with subcategories).
2. Baseline the requirements and monitor this baseline.
3. Identify changed requirements; remove, add and refine requirements
4. Impact analysis of changed requirements on current and previous ADM phases
5. Implement requirements arising from Phase H Architecture Change Management
   Taking on board the lessons learned from D 4.3, D4.7, D4.11 (Initial Running Phases) and D4.13 (Methodology and Mid-Term Evaluation Report).
6. Update the requirements repository[1]
7. Implement change
8. Gap analysis for past phases

Output

- Architecture Requirements Specification
  For WP2 this means:
  a. D2.4 Project Start Architecture (PSA) first iteration
  b. D2.7 Optimal Architecture for Cross-border procedures and evidence exchange considering the Single Digital Gateway Regulation (REGULATION (EU) 2018/1724) (SDGR)
  c. D2.5 Project Start Architectures (PSA), second iteration
  d. D2.8 Beyond interoperability: One Network for Europe (ONE)

[1]At project start MS Excel is used as requirement management tool. Later we might decide on a specific requirement management tool.

4 Architecture Metamodel

The architecture metamodel described in his chapter provides the basic methodological tooling for the development of the DE4A architecture. All models that are created in the context of PSA and SA will apply the modelling concepts described here.

4.1 Starting points

In line with The European Interoperability Reference Architecture (EIRA) [31] we adopt both the ArchiMate [1] language and some aspects of TOGAF Content Model [42]. ArchiMate and some of the specializations provided by EIRA form the basis for the extensional architecture metamodel covering Business, Application and Technology Architectures and source of the definition of architecture elements.

We also distinguish different levels of abstraction (see 4.2) as already proposed in the original Zachman framework and also engrained in TOGAF concepts of Architecture Building Blocks (i.e. Conceptual/Functional), and Solution Building Block (i.e. Logical) and Solution (i.e. Physical).

The motivational aspects of the DE4A Architecture will focus on requirements and principles (see chapter 7). These aspects will not be modelled out in terms of diagrams, but rather documented in tables or other structured documentation. We intend to structure requirements along the five aspects of The European Interoperability Framework (EIF).

4.2 Levels of Abstraction

Abstraction is at the core of creating models and is even engrained in the way our minds understand the perceivable world around us by leaving out irrelevant details and focussing on the essential. Abstracting in a very goal-oriented and diligent manner is crucial for good architecture, giving rise to several levels of abstraction. This framework distinguishes three levels of abstraction:

- Conceptional/Functional
- Logical
- Physical

At the lowest, the Physical level, one element of the model represents one object in the perceivable reality, i.e. one instance of a software system, or one device. On the application and technology layer, we consider single license applications or addressable notes. In terms of the EIRA 3.0.0 Metamodel (see Figure 2), this level of abstraction corresponds best with Solution, an aggregation of solution building blocks that can readily be used.

The logical level groups all elements together which are identical in all relevant properties, sometimes also referred to being of the same “type”, i.e. Windows 10, iPhone 10. On the application and technology layer, we consider version-specific application components or devices with identical serial number. In terms of the EIRA 3.0.0 Metamodel (see Figure 2), this level of abstraction is in line with the notion of Solution Building Block (SBB) and Interoperability specification. There can be many implementations in existence that are identical in their specification.

The conceptual or functional level goes one step further and classes all elements together that fulfil essentially the same function, sometimes also referred to be the same “sort”, i.e. operating system, smart phone. In terms of the EIRA 3.0.0 Metamodel (see Figure 2), this level of abstraction corresponds to the notion of an Architecture Building Block (ABB).

Essentially, any elements of the extensional architecture metamodel can exist on all three levels. This implies that any element defined in the section 4.3 below - e.g. Process, Application Component, Node - can be represented on the conceptual, logical and physical level of abstraction. Ideally, one diagram

– one architecture view - only depicts elements of the same level of abstraction, but for practical reasons, a mix is also possible (i.e. for communication views).

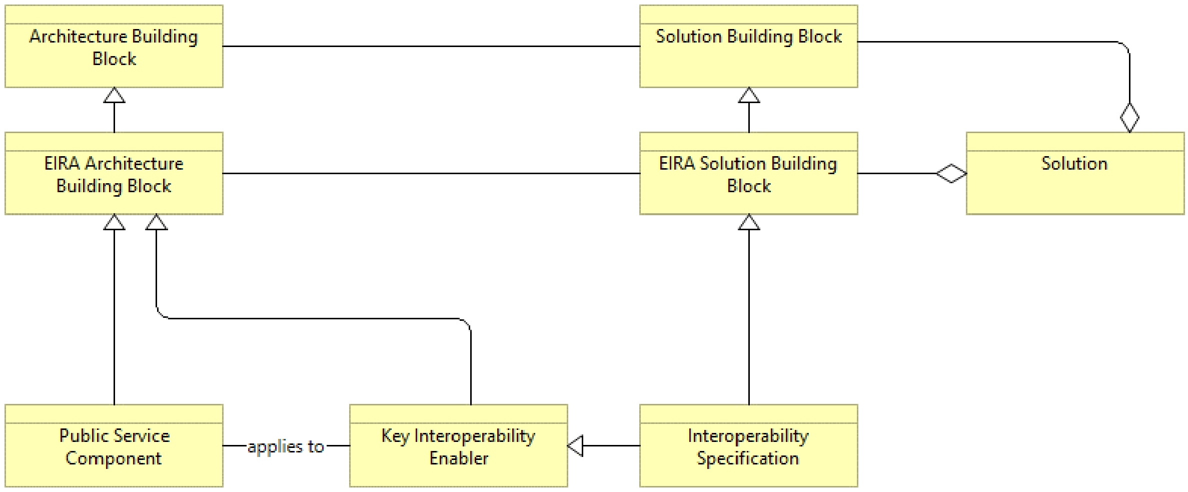

Figure 2: Excerpt of the EIRA Metamodel View.

In architecture practice we observe some correlation between levels of abstraction and architecture layers: Business architecture is mostly concerned with Conceptual, Application mostly with Logical and Technology leaning towards the Physical layer.

In business architecture, for example, architects are mostly concerned with defining conceptual reference processes. Specifying logical level, repeatable and implementable process is usually the realm of business analysts and business consultants, whereas dealing with the particularities and issues of one specific, “physical” process instance is in an operational responsibility.

Application architecture often starts with a conceptual/functional architecture of the application or application landscape made up of ABBs, which is then subsequently elaborated into a logical application architecture consisting of SBBs. In DE4A, this step is at the handover between WP2 ‘Architecture Vision and Framework’ and WP4 ‘Cross-border Pilots for Citizens and Business and Evaluation’. WP2 is in the lead for the conceptual architecture described in the Project Start Architecture, whereas the main responsibility for the logical level solution architecture resides with WP4; this in close cooperation and support of WP2.

4.3 Extensional Metamodel, based on ArchiMate

In line with EIRA, DE4A uses ArchiMate [1] in the current version as the basis for our extensional Metamodel. This means, for example, that we adopt the definitions and the ArchiMate Core Framework. If we speak in the context of this document, for example, about Element or Relationship, we do this with the meaning ascribed to them in the ArchiMate specification.

The choice for ArchiMate does not preclude the use of more specialized modelling methods and languages to detail aspects in parts of the architecture, for example, Business Process Model and Notation (BPMN) [3] for business processes or the Unified Modeling Language (UML) class diagrams [44] for data objects. For wider interrelations, elements must be represented using ArchiMate. The mapping of elements from more specific modelling languages to the ArchiMate concepts is provided in the sections below.

4.3.1 The ArchiMate Core Framework

The ArchiMate core framework is a 9-field matrix, consisting of three Layers and three Aspects (see Figure 3). DE4A uses this framework and the Elements and Relationships contained therein.

Three layers are defined within the ArchiMate core language as follows:

1. *The Business Layer depicts business services offered to customers, which are realized in the organization by business processes performed by business actors.*
2. *The Application Layer depicts application services that support the business, and the applications that realize them.*
3. *The Technology Layer depicts technology services such as processing, storage, and communication services needed to run the applications, and the computer and communication hardware and system software that realize those services. [1]*

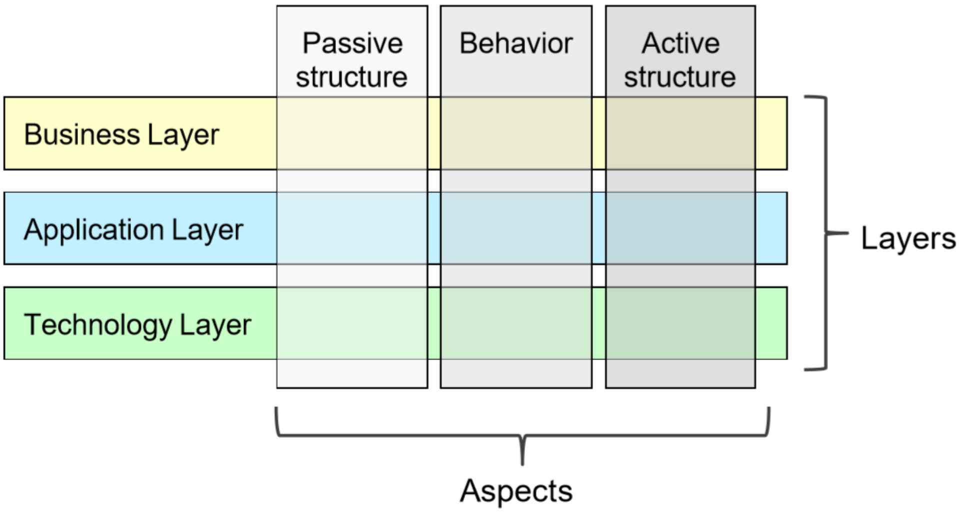

Figure 3: ArchiMate Core Framework [1].

The three Aspects defined within the ArchiMate core language as follows:

1. *The Active Structure Aspect, which represents the structural elements (the business actors, application components, and devices that display actual behaviour; i.e., the "subjects" of activity).*
2. *The Behaviour Aspect, which represents the behaviour (processes, functions, events, and services) performed by the actors. Structural elements are assigned to behavioural elements, to show who or what displays the behaviour.*
3. *The Passive Structure Aspect, which represents the objects on which behaviour is performed. These are usually information objects in the Business Layer and data objects in the Application Layer, but they may also be used to represent physical objects.* [1]

Each of the 9 fields contains several Elements and Relationships in the metamodel of the complete ArchiMate language. DE4A makes an informed choice of these elements in order to support the modelling for the OOP use cases. The choice described in this version of the document is preliminary and might be extended as the project progresses. The three sections below describe the elements of the Business, Application, and Technology layers, respectively; the order in which the elements are described per layer is middle-out, meaning first the behaviour aspect, then the active structure and last the passive structure aspect.

4.3.2 Business Architecture Elements

4.3.2.1 Business Service

A business service represents explicitly defined behaviour that a business role, business actor, or business collaboration exposes to its environment. [1]

The notion of a business service is important; however, in the current version of the framework, we do not include it as one of our initial viewpoints. In the EIRA metamodel, the business service is specialized into a public service. If we consider the level of overall service delivery to citizens and businesses, the long-term perspective (see t=4 in 5.5) of DE4A would also include services provided by semi-governmental and private sector actors. From an SDG perspective, the public services are defined by the list of 21 procedures and 4 Directives mentioned in Article 14 of the SDGR [37] .

A discussion on what exactly the Business Service is that the Once-Only Technical System is delivering might be interesting, but it is at the moment not considered to be the most pressing topic to elaborate. The decomposition of Once-Only into more granular business services might yield valuable results, however, we expect that such decomposition comes much more naturally on the level of business process analysis.

4.3.2.2 Business Process

A business process represents a sequence of business behaviours, which achieves a specific result, such as a defined set of products or business services. [1]

Whereas EIRA appears to take a traditional information engineering perspective, focusing on passive structure elements and services on the business layer, DE4A is taking the business process as a core element of the business architecture. This is in line with the approach of the CEF Preparatory Action for the Once-Only Technical System, which recognises the importance of a user perspective and attempts to define user journeys.

The DE4A metamodel adopts the specialization of business activity as proposed by section 15.2.1 of the ArchiMate 3.1 Specification [1] and extends this specialization to Sub-process and Task in line with the two activity types of the BPMN 2.0 specification (see 4.3.5.1 below).

4.3.2.3 Event

A business event represents an organizational state change. Business processes and other business behaviour may be triggered or interrupted by a business event. [1]

Events are, next to Activities, fundamental elements of business processes in BPMN [3]. In adopting BPMN, we consider all event types defined by the BPMN 2.0 Specification - such as start, intermediate and end events or timer and message events - as specializations of the Business Event as defined in ArchiMate.

4.3.2.4 Business Role

A business role represents the responsibility for performing specific behaviour, to which an actor can be assigned, or the part an actor plays in a particular action or event. [1]

Roles in our meta model represent a typification at individual organizational level of actors that share the same responsibilities, capabilities or requirements. We adopt the three fundamental roles defined by TOOP [43]: User, Data Consumer (DC) and Data Provider (DP).

At the logical level of abstraction, we expect to define these roles, or potentially even more fine-grained roles, as stereotypes to be reused. These specializations are direct specializations from the ArchiMate business role concept and not from the EIRA specializations, namely Public Service Provider and Public Service Consumer. The main reason here is again that in our long-term perspective, actors from the private sector will also act as DP and DC.

4.3.2.5 Business Collaboration

A business collaboration represents an aggregate of two or more business internal active structure elements that work together to perform collective behaviour. [1]

We include the collaboration element in our meta model because it proves very practical during the iterative development of architecture views. In our case, a business collaboration would usually represent a collaboration between roles rather than actors. It can be used, for example, to show that the division of responsibilities for a section of the process is not yet clearly divided between these two roles. Oftentimes, this points to the need of a further discussion to reach a decision on precise business responsibilities.

4.3.2.6 Business Actor

A business actor represents a business entity that can perform behaviour. A business actor can represent such business entities at different levels of detail and may correspond to both an [individual] actor and an organizational unit in the TOGAF framework. [1]

In the context of DE4A - and at the physical level of abstraction - business actors are natural person, legal person and competent authority.

4.3.2.7 Business Object

A business object represents a concept used within a particular business domain. [1]

We do not expect to do extensive business object modelling in DE4A. Business objects can represent anything from a single attribute up to a complex, structured data set, or even and unstructured document. One specialization, which is most prominent in the SDG context, is Evidence (see definition in Annex A). We expect to introduce Evidence as a specialization of Business Object for modelling at the logical level of abstraction.

4.3.2.8 Representation

A representation represents a perceptible form of the information carried by a business object. [1]

We introduce the Representation element in our meta model especially and specifically to tackle the prevalent discussion of different formats of evidence in the SDG context. In this context, one evidence can be represented by a formal document or a structured data set from an authentic source, or by a combination of both in the hybrid approach used in eJustice and proposed by the 'Study on Data Mapping for the cross border application of the Once-Only Technical System SDG' (forthcoming).

In the context of business process modelling, using BPMN, the academically correct mapping of the BPMN Message would be the ArchiMate Representation. For the sake of simplicity in modelling, we will use a derived (a)ccess relationship directly to the Business Object, representing the "payload" of the message, when transferring elements from the specialized, BPMN-based, Business Process Collaboration Viewpoint (see section 4.3.5.1) to more general ArchiMate viewpoints.

4.3.3 Application Architecture Elements

4.3.3.1 Application Service

An application service represents an explicitly defined exposed application behaviour. An application service exposes the functionality of components to their environment. This functionality is accessed through one or more application interfaces. [1]

The Application Service is the linking-pin between the Business Process and the Application Component. These application services will be identified in the context of the business process realization viewpoint. We do not intend to use application services as an element to model application to application exchange, at least not at this moment. If the need arises, for example, in the context of governance and sustainability in WP6 'Sustainable Impact and new governance models', we could include those at a later time in our framework as an anchor point for the definition of Service Level Agreements.

In DE4A, Application Service will also be used to provide a functional classification of application behaviour that can be consumed by different business processes. This classification is based on EIRA and TOOP and will be compiled and refined in the context of next task. It will provide the structure of the catalogue of SBBs, which realize this kind of service.

4.3.3.2 Application Component

An application component represents an encapsulation of application functionality aligned to implementation structure, which is modular and replaceable. An application component is a self-contained unit. As such, it is independently deployable, re-usable, and replaceable. [1]

Solution Building Blocks, or more precisely an implementation of the technical aspects of SBB, is represented as an Application Component in the DE4A architecture.

4.3.3.3 Application Collaboration

An application collaboration represents an aggregate of two or more application internal active structure elements that work together to perform collective application behaviour. [1]

Similarly to the Business Collaboration, we include the Application Collaboration element in our meta model because it proves very practical during the iterative development of architecture views. For example, we can use it in situations where the integration of several existing SBBs is still under discussion, while the services that they collaboratively are meant to deliver can already be defined.

4.3.3.4 Application Interface

An application interface represents a point of access where application services are made available to a user, another application component, or a node. [1]

Diligently identified, and clearly specified interfaces are crucial for achieving loose coupling in the OO Architecture. We use the interface element in the context of the process realisation viewpoint to model the interrelations between independent application components.

4.3.3.5 Data Object

A data object represents data structured for automated processing. [1]

This means that a data object can be of different granularity, reaching from a single attribute to a complex object, and even to a structured data set consisting of several objects.

For detailed work on data models, for example in context of WP3 'Semantic Interoperability Solutions' and WP5 'Common Component Design & Development', we plan to use the UML class diagram notation to represent in more detail the interrelation between data objects at differing levels of granularity.

4.3.4 Technology Architecture Elements

4.3.4.1 Technology Service

A technology service represents an explicitly defined exposed technology behaviour. A technology service exposes the functionality of a node to its environment. [1]

Technology services are provided by standard software components or appliances and used by application components to create their behaviour. Please consider that the distinction between application and technology layer in ArchiMate is not equivalent to the distinction between application and infrastructure / network as, for example, in the OSI model.

4.3.4.2 Node

A node represents a computational [..] resource that hosts, manipulates, or interacts with other computational [..] resources. [1]

The definition of Node encompasses any virtual or physical server or active component required to operate the overall system. Apart from the technological architecture aspects, we also use Node in logical and physical architecture representations to describe the ownership off the computational resource via an association to an actor, typically an organization.

4.3.4.3 System Software

System software represents software that provides or contributes to an environment for storing, executing, and using software or data deployed within it. System software is a specialization of a node that is used to model the software environment in which artefacts run. This can be, for example, an operating system, a JEE application server, a database system, or a workflow engine. [1]

We also consider standard software components providing low-level services as part of the security architecture, or messaging infrastructure as being system software, exposing their behaviour to application components via technology services.

4.3.5 Main Architecture Viewpoints of the Extensional Architecture

The architecture framework described in this document starts with a minimum set of viewpoints that are in turn kept to a minimum set of elements and relationships, in order to create “just enough architecture” and not trap into the pitfall of creating architecture for architecture’s sake. The viewpoints described below are broadly derived from the example viewpoints of the ArchiMate 3.1 specification.

4.3.5.1 Business Process Collaboration Viewpoint

We adopt the BPMN 2.0 Collaboration Diagram as a specialisation and simplification of the Business Process Cooperation Viewpoint (see C1.10 of the ArchiMate 3.1 Specification [1]). In addition, we start with a simplified, minimum set of BPMN 2.0 elements for modelling the business process, excluding all BPMN 2.0 elements that are geared towards the modelling of deterministic processes for process automation and service orchestration. This should not preclude the use of BPMN as part of technical specifications at a later stage of the project. Table 2 lists our choice of BPMN elements and provides a mapping to (specializations of) ArchiMate 3.1 elements.

Table 2: Element Mapping between BPMN 2.0 and ArchiMate 3.1.

Participant (Pool)	(Specialisation of) Business Role
Lane	(Specialisation of) Business Role
Message	Business Object (not Representation, see 4.3.2.8 above)
None Start Event	(Specialisation of) Business Event
Message Start Event	(Specialisation of) Business Event
Timer Start Event	(Specialisation of) Business Event
None Intermediate Event	(Specialisation of) Business Event
Time Intermediate Event	(Specialisation of) Business Event
Catching Intermediate Message Event	(Specialisation of) Business Event
Throwing Intermediate Message Event	(Specialisation of) Business Event

None End Event	(Specialisation of) Business Event
Message End Event	(Specialisation of) Business Event
Termination Event	(Specialisation of) Business Event
Sub-Process	(Specialisation of) Business Event
Abstract Task	(Specialisation of) Business Activity
Manual Task	(Specialisation of) Business Activity
User Task	(Specialisation of) Business Activity
Service Task	(Specialisation of) Business Activity

We expect to use a collaboration diagram involving three participants, as illustrated in Figure 4 below: User, Data Consumer, Data Provider; Data Consumer and Data Provider are in turn subdivided in more specialized roles. For a definition of these seven roles, see Annex A. In this way, we expect to get a transparent view of the interrelation between those main participants and the required messaging (called Conversation in BPMN) between them.

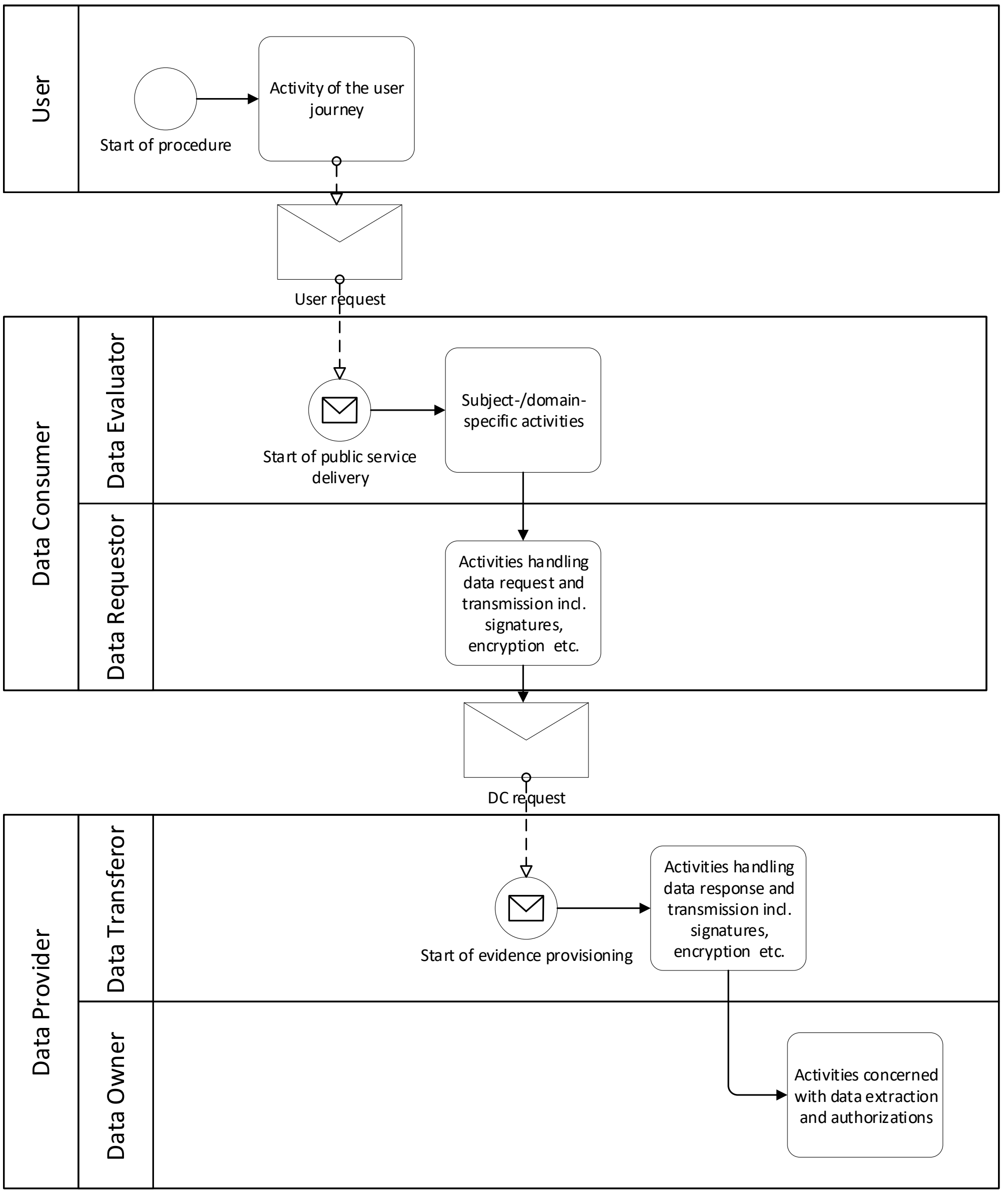

Figure 4: Illustration of the use of the BPMN Collaboration diagram in OOP Context.

This approach is consciously chosen in order to provide an easy alignment with customer/user journey mapping approaches: In the User Pool, we model the public process of the user, i.e., that is the sequence of steps that they take on their journey, which in turn is essentially what the SDGR [37] calls a Procedure: *a sequence of actions that must be taken by users[…].* The Message Flows between the User pool and the pools representing the roles of Data Consumer and Data Provider correspond to user interactions in terms of user journey mapping. This means that the business process analysis supported by this viewpoint can easily be translated into Customer Journey Maps for communication purposes.

4.3.5.2 Process Realization Viewpoint

The process realization viewpoint is adapted from the Service Realization Viewpoint mentioned in the ArchiMate 3.1 specification. It will be the most important viewpoint of the DE4A architecture in defining which application services are required and which application components realise these services in order to execute the business activities derived from the business requirements, as shown in Figure 5 below. Used as design viewpoint, we expect to create one view per participant business process. Used as communication viewpoint, we subsequently might combine them together to represent the complete scope of one business process collaboration.

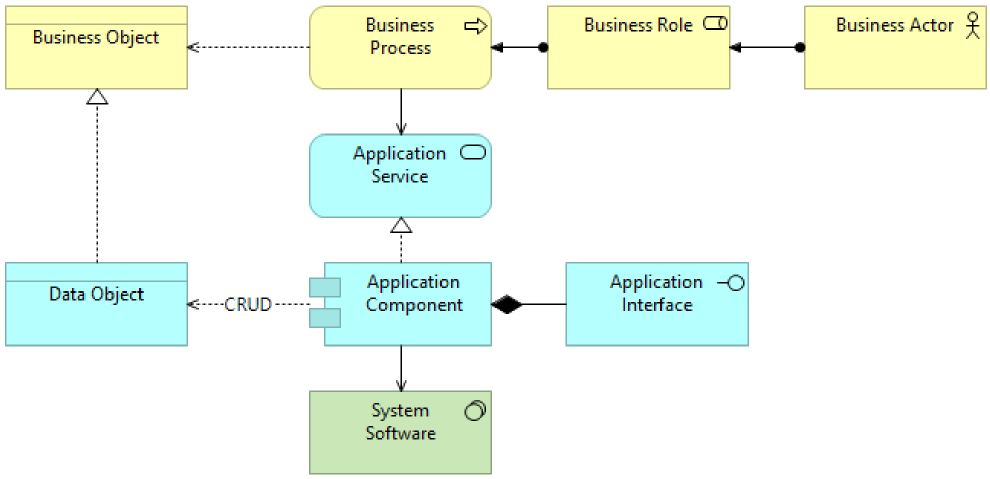

Figure 5: Metamodel of the Process Realization Viewpoint.

In the functional representation of our architectures, we will represent the assignment of activities to roles already defined in the business process collaboration viewpoint. In the solution architecture context, on the logical level, the assignment to Actors becomes more important to represent the specifics of the individual domains. In the context of pilot implementation, we might even draw process realization views on the physical level of representation, where actors would represent specific organizations.

System Software is included in this viewpoint without the intermediate Node, in order to document low-level software components required for the application components to run. We do not expect this to be used excessively, but it should help preclude the creation of application components to depict these low-level components and thus clutter the application layer with technology details.

4.3.5.3 Implementation and Deployment Viewpoint

The implementation and deployment viewpoint in DE4A is a direct adaptation of the Implementation and Deployment Viewpoint of the ArchiMate 3.1 specification. Used as a design viewpoint, we expect to create one view per application service, or for a small group of closely related application services. The viewpoint is used to show how the application services are deployed on different nodes or how they reuse technology services from other nodes to create their behaviour as shown in Figure 6.

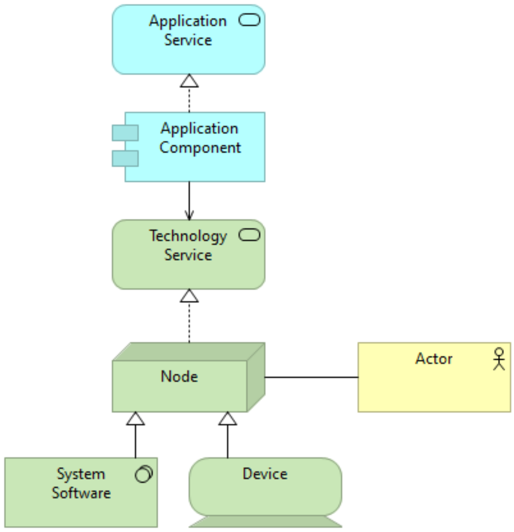

Figure 6: Metamodel of the Implementation and Deployment Viewpoint.

We expect that the first implementation deployment views will be drawn up in the context of the solution architecture definition for our pilots, which means that they will be on a logical level of abstraction. In the context of further task, we will abstract from these logical views and from insights gained through the analysis of prior work to create conceptual reference implementation views in order to contrast different implementation and deployment options.

5 Architecture Time Horizons

Currently, the Single Digital Gateway Regulation (SDGR) [37] dominates the discussion of online public services and procedures. The impact of this regulation on the EU, the Member States and essentially all authorities and institutions involved in the delivery of public services is substantial and must not be underestimated. DE4A is assessing and supporting "new forms of delivering public goods and services" and consequently must provide policy makers and competent authorities with a vision of the SDG target architecture, focused on Once-Only-Principle-compliant, Digital-by-Default procedures, that can provide direction to the SDG implementation effort over the course of the next four years.

A strict focus on the SDGs, 2023-year horizon, however, is not practicable for two reasons. First, the first implementation of the Once-Only Technical System should be a well-balanced step towards the emergence of a wider European Digital Single Market Ecosystem, in order to be sustainable. Second, it must be geared towards the integration of new technologies, such as blockchain, big data analytics and machine learning, in order to safeguard the future international competitiveness of the European Digital Single Market. Therefore, the architecture framework covers several time horizons as shown in Figure 7.

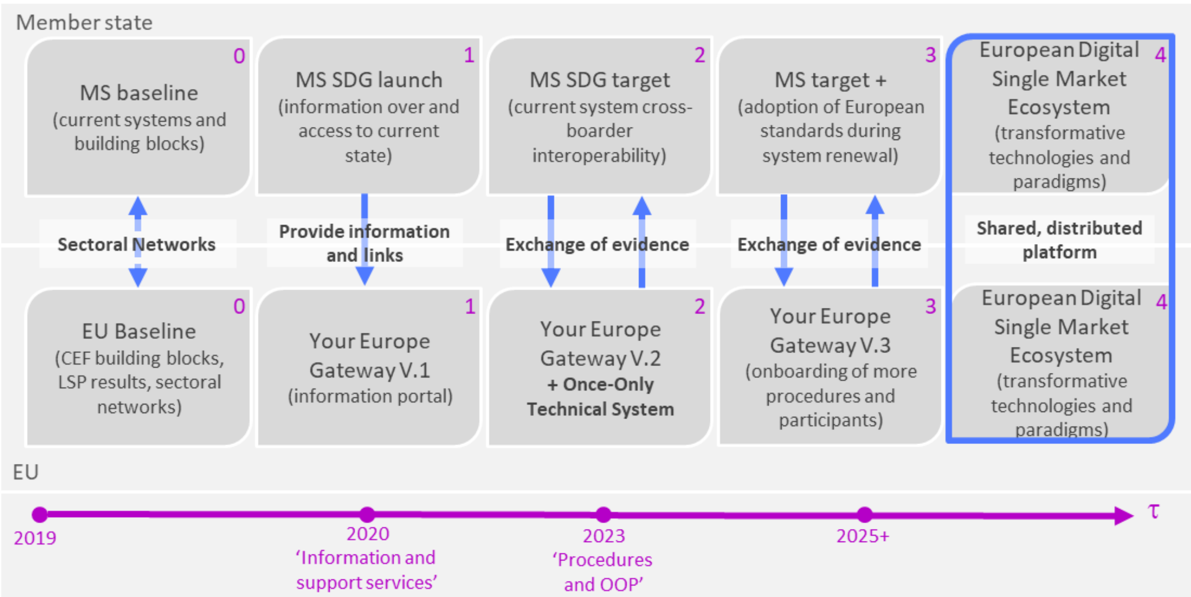

Figure 7 : Time Horizons 0 to 4 of the DE4A Architecture Framework.

In total, five distinct horizons are identified and numbered 0 to 4, starting from the left with (0) the current status quo – the baseline – and reaching via (2) the SDG 2023-time horizon in the middle to (4) a long-term future state to the right. In addition, Figure 7 distinguishes between a European level (EU) in the lower half and a Member State (MS) level in the upper half, which essentially means that it represents 27 different, distinct architectures that need to be integrated. Summarizing, the framework includes the following architecture scopes: M0, MS1, MS2, MS3, MS4 (for 27 MS) and EU0, EU1, EU2, EU3, and EU4.

DE4A has the European level as focus, as covering 27 distinct national developments in detail is neither possible, nor desirable from a subsidiarity point of view. In addition, the project will take a close look at the baseline at both the European level, as well as the participating Member States (i.e. WP1 'Inventory of current eGovernment landscape') and will cover both levels in the pilot implementations in productive systems (i.e. WP4 'Cross-border Pilots for Citizens and Business and Evaluation', supported by WP3 ‘Semantic Interoperability Solutions’ and WP5 ‘Common Component Design & Development’).

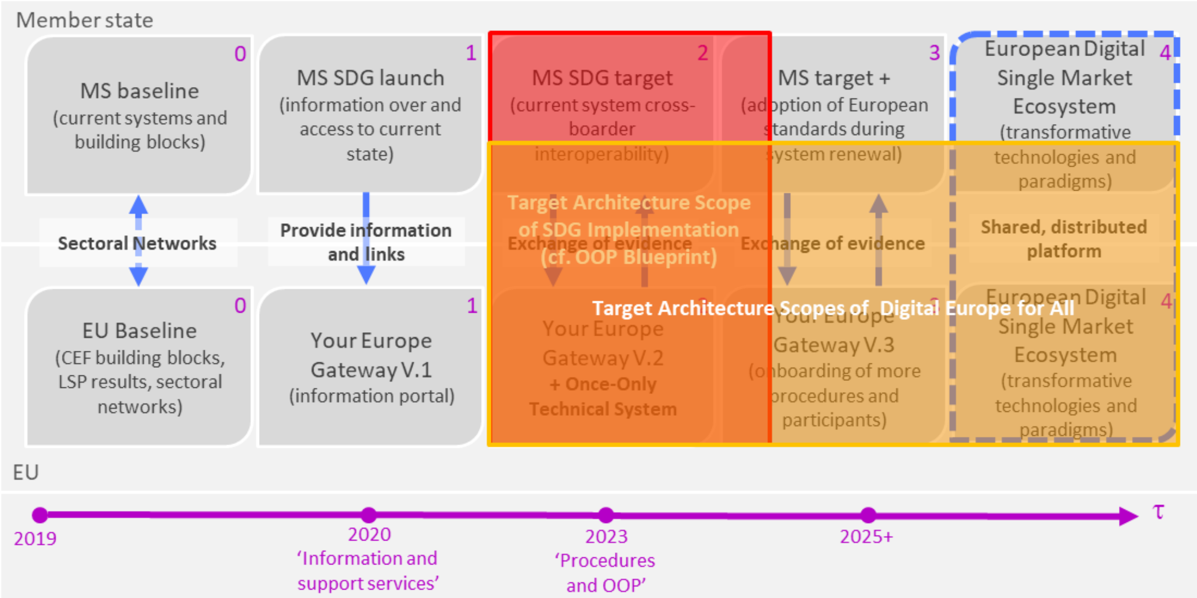

Figure 8 : Overlap of the Target Architecture Scope of DE4A and SDG Implementation.

We believe this basic framework will support the distinction and communication of requirements and concerns that are absolutely vital to the first MVP implementation of OOP (t=2) and such requirements that – though not less important in substance – can be better accommodated in the roadmap beyond (t=3 and t=4). In addition, this would provide a solid basis for managing the overlap in the target architecture scope of the SDG implementation and DE4A as shown in Figure 8 above.

5.1 t=0 Baseline

The baseline architecture assessment at the European level focusses on the functional aspects of existing building blocks (i.e. CEF, LSP, TOOP, ISA2). The focus is on their suitability for future implementations (i.e. SDG), both from a technical and from an organisational/business point of view. After all, organisational barriers for implementation can weigh heavier than technological ones in an ecosystem of 27 Member States and their thousands of authorities and institutions.

The baseline assessment of each Member State concentrates on the identification of data management and Once-Only-Principle-compliant interaction patterns that should be considered in the SDG architecture vision. WP1 ‘Inventory of current eGovernment landscape’ is clearly related to the baseline architecture and extends the assessment to the identification of communication endpoints per procedure in each participating MS that are relevant for Pilots.

5.2 t=1 (12.2020) Your Europe Gateway Version 1 – Information Portal

The first version of the Your Europe Gateway is due to be operational by the end of 2020 [37] and must cover the information and help services use cases. This is arguably of lesser relevance for the scope of this project; however, there are interrelations in the level of semantic interoperability. The Your Europe Gateway is expected to include a semantic layer, a common SDG Data Model, aligned with the CPSV-AP, which is at the moment developed in the context of ISA2. In addition, a Form Generator that might or might not become an official part of the ICT-Tooling of the SDG implementation effort should be taken into account as a potential UI building block.

Another aspect of this horizon is the large overlap of competent authorities involved in the information use case due in 2020 and the procedures use case due in 2023. This means that the work done on the information use case outside of this project might provide a good platform for communication and dissemination of project results. Other than this, MS1 is not in the scope of DE4A.

5.3 t=2 (12.2023) Your Europe Gateway Version 2 + Once-Only Technical System Version 1

On the 12/2023-time horizon, the full implementation of the SDG moves centre stage and provides the central focus for this project. The target architecture can follow different basic interaction patterns, potentially in parallel, integrating existing European building blocks to the maximum extent possible (i.e. CEF, LSP, ISA2, TOOP). In technical terms, we expect that implementing Your Europe Gateway v2 is rather a matter of system integration than software development.

This time horizon has a strong overlap with the CEF Preparatory Action for the SDG Once-Only Technical System, the corresponding Implementing Act (by 12 June 2021) [37] and the ensuing SDG implementation. The CEF Preparatory Action is developing a high-level OOP blueprint focussed on this target architecture time horizon. DE4A is following and contributing to this development and takes it into account in identifying relevant interaction patterns (see chapter 8).

Different interaction patterns, bundled with relevant existing and emerging building blocks and guiding architecture principles form the Project Start Architecture, will be put to test in the Pilot use cases (WP4) that show the best functional fit. In addition, these patterns are evaluated against documented pilots from prior projects (e.g. TOOP), if information can be made available to DE4A.

On Member State level, the collection of national communication end-points (see WP1 'Inventory of current eGovernment landscape') is classified into integration patterns of the reference architecture and mapped to European building blocks that can support their integration at solution level. In this way, Pilots receive a common framework and a structured solution space of building blocks and components to choose from during their implementation. The aim is to be non-prescriptive, i.e. narrowing the solution space to a single solution, but to provide by the end of this project a well-structured architecture framework and solution catalogue, including pointers to reference implementations (i.e. our Pilots), that can support both policy makers, i.e. during the formulation of Implementation Acts, and implementation projects in making informed choices.

5.4 t=3 (approx. 2025) Once-Only Technical System Version 2

The European architecture is still geared towards the transfer of evidence between MS systems. From the project perspective, the focus is on foreseen, incremental improvements and widening of the scope of the overall system. We foresee two types of possible improvements on this time horizon: (1) the implementation of interaction patterns that are not required for SDG or proved impracticable to include for the 2023-time horizon (e.g. because of technological or other barriers); (2) the stepwise inclusion of new technologies, i.e. the use of blockchain technology for logging cross-border transactions or machine learning for the analysis of user statistics or adaptive expansion of the semantic mapping. In a way, this time horizon is for us the "real" target architecture for the Once-Only Technical System (cf. D2.7 'Optimal Architecture for Cross-border procedures and evidence exchange considering the Single Digital Gateway Regulation'), with the 2023 implementation being a first, minimal viable implementation.

Another future development that is important to consider, is an increasing scope and scale of the overall system landscape. This growth can move along two dimensions and the corresponding scalability requirement must already be taken into account in the first version of the Once-Only

Technical System (t=2 above). One dimension is the number of procedures, that is expected to grow beyond the mandatory list of the SDG Regulation, e.g. by gradually replacing domain-specific solutions. The second dimension is the number of participating actors. Whereas the SDG focuses on evidence transfer within the public administration domain, inclusion of private and third sector participants in sharing common services will bring truly added value for citizen and businesses. Considering, for example, the 360° perspective of “moving”, which includes the purchase of a new home: identity, income, place of residence and land ownership information is equally relevant for banks, notaries and real-estate agencies involved in the process - many thousands of additional actors across Europe. DE4A adopts a life event perspective in the initial analysis for the Pilot projects (see WP4) and the research on new governance models (see WP6 ‘Sustainable Impact and new governance models’), while directing the focus of the technical pilots towards a functional scope aligned with the SDGR.

The Member State level of this time horizon will only be covered to a minimum extent in DE4A, as it will mostly concern the adoption of European standards in regular system renewal cycles.

5.5 t=4 (long term) Digital Single Market Ecosystem

In the long run, we envision the blurring of the line between European and MS systems. This must not have any implications for the subsidiarity principle or the recognition of different levels of public administration in Europe. Purely from an information processing perspective, the fact that two competent authorities are residing in two different Member States is of secondary importance when communicating via the European Digital Single Market Ecosystem.

From a project perspective, architectures for this time horizon, including corresponding Pilot developments, are the sandbox for demonstrating the transformative impact of new technologies, such as blockchain. We expect to derive insights into the non-technical adoption barriers for these technologies and their corresponding structural changes. Furthermore, this future vision shall guide us in making informed and sustainable choices when implementing versions 2 and 3, as explained in section 5.6 below.

5.6 A Subtractive Approach to Defining the Once-Only Technical System

An important aspect of our approach to Architecture is to ensure that the first implementation of the Once-Only Technical System (t=2) is a stepping stone for the long-term vision of an open and distributed European Digital Single Market Ecosystem. Solutions must either be scalable in scope and complexity to be sustainable in the long-term or recognized as temporal with a potential future replacement identified on the roadmap.

In order to achieve the above, DE4A employs a subtractive approach: we start by envisioning the European Digital Single Market Ecosystem in t=4 and define it in terms of guiding principles (see chapter 7). Analogous to a sculptor, using the subtractive technique, we chisel away everything that is preliminarily unnecessary, temporarily impracticable, or which requires a longer time for adaptation (cf. barriers to interoperability) in order to arrive at a solution that is in line with the requirements and possibilities of t=2 and t=3 (i.e. D2.7 ‘Optimal Architecture for Cross-border procedures and evidence exchange considering the Single Digital Gateway Regulation’).

Collecting everything that we chipped off and documenting it in terms of exceptions to defined principles in our Architecture Log will make us aware of the pragmatic choices we make and why we made them. This Architecture Log is in turn a key input into a tentative roadmap to the attain the long-term target architecture (i.e. D2.8 ‘Beyond interoperability: One Network for Europe (ONE)’). This is not a trivial “re-assembly” similar to the sculptor who cannot glue together the splinters to attain the original form. The original vision laid out in this document is also more high-level and framed in terms of principles than the target architecture vision of D2.8 should be.

Finally, we attempt to conceptualize business and governance models (see WP6) that allow a gradual, natural evolution towards that end-state. In this way, we hope to make the Once-Only Technical System not only a stepping stone, but an actual step in a development, a step that holds in itself the momentum for the next step along the road.

6 Long-term Architecture Vision

The Digital Single Market (DSM) strategy, means to ensure the free movement of goods, persons, services and capital, is built on three pillars: (1) improved access for consumers and businesses to digital goods and services across Europe; (2) creating the right conditions and a level playing field for digital networks and innovative services to flourish; (3) maximising the growth potential of the digital economy. These three objectives guided the development of the long-term vision.

6.1 Multi-Pattern Technical Architecture

If we look at the Once-Only Technical System, we are convinced that a "one size fits all" solution would not be successful. This is due to several reasons. First, such a solution will need to integrate with different, heterogeneous national baselines, as shown across the top of Figure 9, and even more profoundly, different national digitalization strategies and roadmaps. Second, the procedures listed in Annex II, cover different sectors and have specific requirements for an optimal evidence exchange. Finally, we expect the 21 procedures (+ four Directives) not to be a limitative set, but to grow over time to include additional procedures and also extend to services provided by private-sector participants and novel business models. Consequently, the Technical Architecture Framework of DE4A is built with flexibility and extensibility in mind.

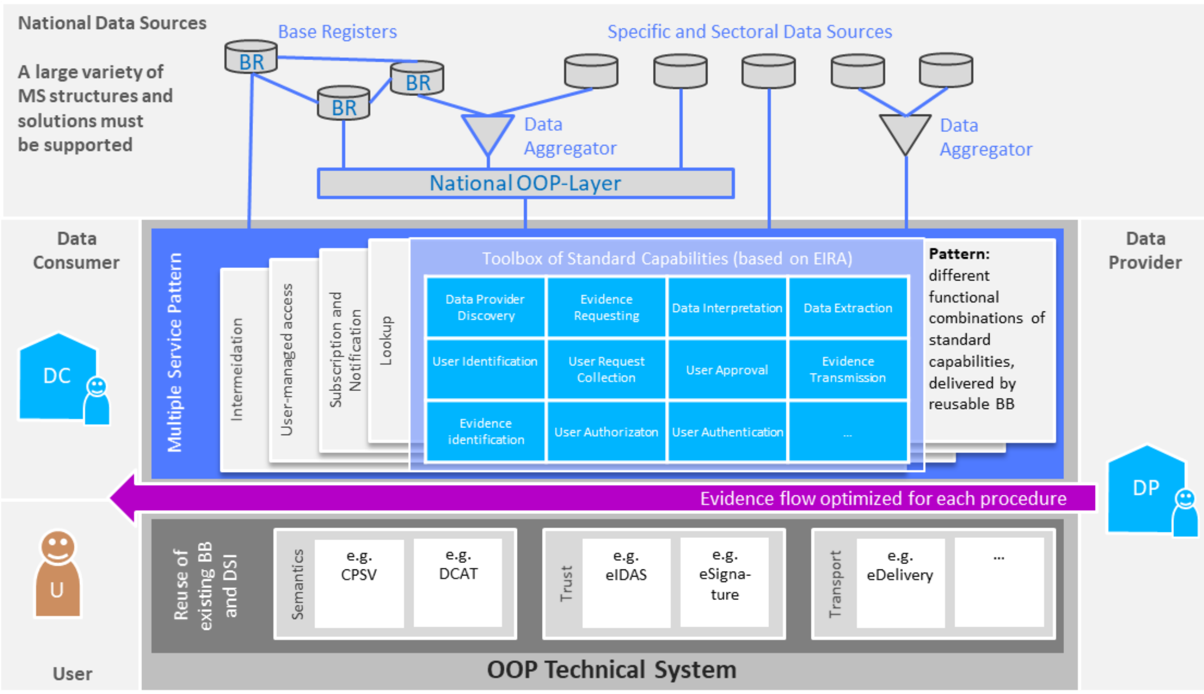

Figure 9 : Multi-Pattern Technical Architecture Framework.

The framework brings together EIRA, existing building blocks, results from large scale pilots in a multi-pattern, service interoperability toolbox. The basis is formed by a validation of existing and emerging technical building blocks that are mapped to functional capabilities, derived from EIRA.

The important question is how these building blocks can be combined into different patterns (see chapter 8), to optimally support evidence exchange. Intermediation, Subscription, Lookup or User-managed access are designed on a functional level and also used to represent the results of previous large-scale pilots. Technical instantiations of these patterns, based on the most promising building blocks, are developed and deployed in our three pilots.

The result is a collection of patterns that are put to a test of reality and consolidated into an OOP target architecture. The framework is meant to become a toolbox that extends beyond the timeline of the project and can be extended with new technologies, building blocks and interaction patterns as they emerge.

6.2 Digital Europe for All

In simple terms, SDG puts forward a list of mandatory high-level use cases that should be implemented by making existing building blocks (with a focus on, but not limited to, CEF and ISA[2]) work productively together (see 5.3 above). Exploring different ways how they can productively work together is at the core of our project; Questions like: Are the building blocks performing well? How do they best fit together? What are meaningful patterns in which to combine them for real service exchange? Where are still gaps, and how can we close them? How can it adapt flexibly to 27 different national MS baselines?

The underlying rationale of the SDG Regulation is one of strengthening the Single Market and it represents a momentum towards a fully operational DSM. The economic rationale is focussed on increasing the efficiency of public administrations and easing the administrative burden for citizens and businesses. If we could combine a best-in-class, efficient and user-centric administration with an ecosystem that fosters digital business innovation, we would make the single market more competitive vis-a-vis America, India, and China.

We take the perspective of enabling innovation in formulating our long-term architecture vision, where we foresee the emergence of a platform that reaches across our national infrastructures and creates seamless interoperability (see 5.5 above). Given Europe's strong democratic traditions, individual freedom and strong administrations, we might just have the advantage on our side. This is how we understand the assertion of EC President Ursula von der Leyen in her Agenda for Europe: "*I believe Europe can successfully manage the transformation into the digital age, if we build on our strengths and values.*" [49]

Our goal is to contribute to making the SDG implementation a significant step into the right direction - into the direction of a Digital Europe for All:

1. All citizens
2. All businesses
3. All public administrations (EU, National, Local)
4. All types of services

A Vision of a European digital single market that leads the way globally.

6.3 European Digital Single Market Ecosystem

What would a technical ecosystem need to look like to support a European DSM allowing free, yet secure and controlled exchange of information and various services between public and private actors? One that can potentially extend beyond the boundaries of the Union? The following high-level requirements come to mind first:

- Robustness and 24/7 availability
- Unlimited growth in terms of type of participants, number of participants and speed of growth
- Authentication of natural and legal persons across the whole ecosystem
- Authorization on the level of single services
- Availability of multiple, economically viable online personas for any single natural person, unequivocally identifiable by competent authorities
- Ability for every European citizen to have full insight into and to exercise full control over who has access to, or can process, their personal information; Ability to revoke this access or

processing right at any time, except where access or processing has a legal basis in the law of the Union or of one of the Member States
- Loosely coupled nodes that allow the flexible integration of new technologies
- Auditability and nonrepudiation of all transactions that correspond to exercising legal rights and obligations, that represent monetary value or that contain information that is not explicitly provided as part of the public domain
- Flexible governance that allows the evolution of the ecosystem and the rules governing the ecosystem firmly rooted in the democratic system of the EU and its Member States
- Economic model for long-term sustainability, based on the economic self-interest of the participants, removing the need for a dedicated source of funding (i.e. budget)

In such an ecosystem, the role of government and public administration would be much more one of a facilitator and market maker, and a provider of trust and verified credentials. The optimal outcome of the SDG implementation, and, specifically, the Once-Only Technical System would be the establishment of a European infrastructure consisting of the first components of this ecosystem. In this context, the information services provided by the competent authorities are representing the first examples of facilitating services, initially for the provision of public services within the 21 procedures (plus 4 Directives), but potentially also for further services rendered by public and private actors and ultimately delivered and exchanged via this very same ecosystem.

DE4A aims to provide a first description of the high-level architecture of this envisioned ecosystem in D2.8 (‘Beyond interoperability: One Network for Europe (ONE)’) by drawing on current and developing European digital government policy, insights from our own pilots and from the developments surrounding the SDG implementation and EUGIP. Already at this point, a useful analogy should help to understand the functioning of the envisioned ecosystem.

The mycelium of mushrooms/fungi is an enormously complex network of fine threads beneath the forest floor, belonging to many different and distinct organisms, yet intensively inter-connected with each other and with the roots of the forest trees. Fungi are life forms without their own source of energy, no photosynthesis and no digestion. We know today that they form a symbiosis with the trees, and that they are as crucial for the survival of the trees as the trees are crucial for them: the mycelium extends the roots of the trees and provides nutrients to them that they otherwise would lack. Additionally, and this is important for our analogy, modern biology found that the mycelium actually connects the trees with each other and appears to facilitate communication between them.

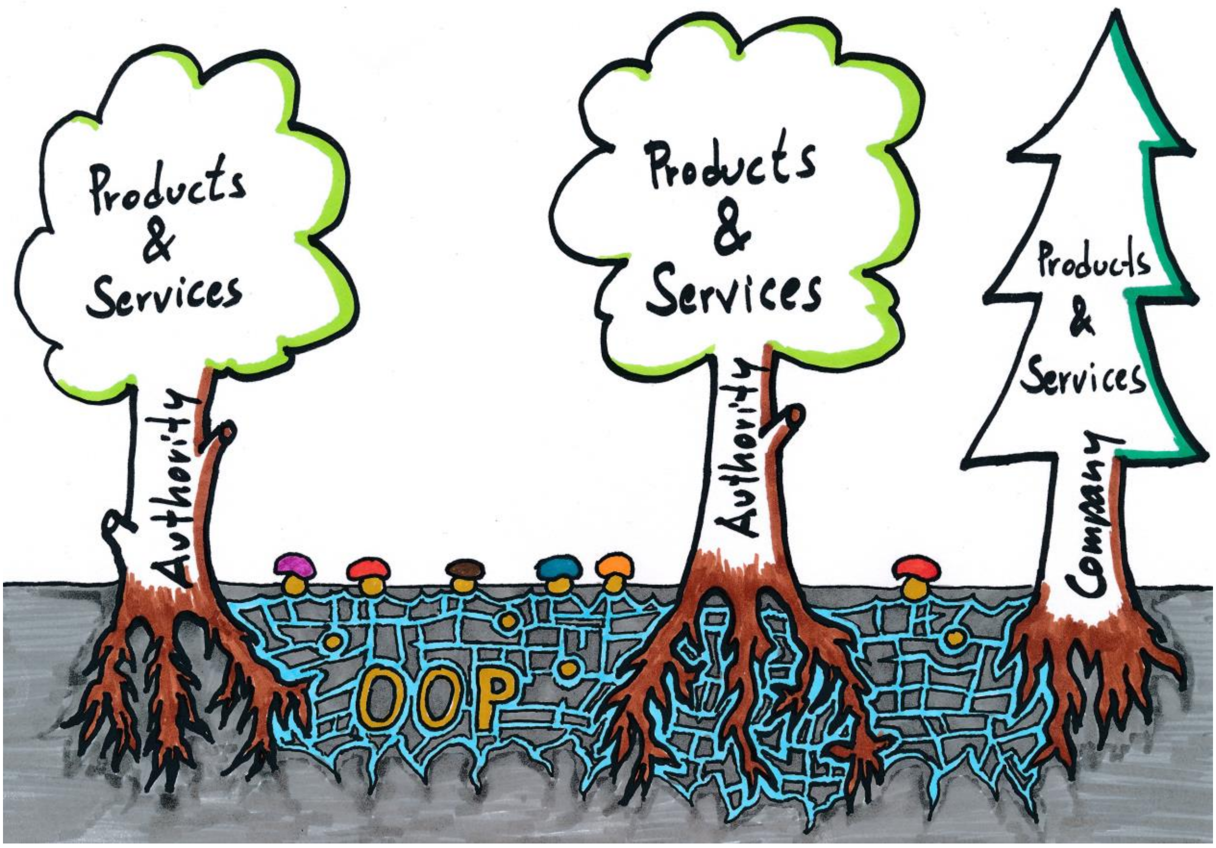

Figure 10: The "Invisible" Mycelium as Analogy for an Optimal OOP Ecosystem.

If we imagine the trees to be competent authorities and business organisations in the European Digital Single Market, and if we imagine the seeds and fruits of the trees to be the services and products delivered by these organisations, then it is easy to imagine the mycelium as representing the OOP ecosystem as illustrated in Figure 10. The network grows organically and decentralized, providing connections where needed. It is composed of different, autonomous organisms that are seamlessly interconnected, similar to different service providers implementing and operating the Digital Single Market Ecosystem. Furthermore, the mycelium gets its nutrients from the trees, analogous to a market-friendly implementation of the Digital Single Market Ecosystem, that is financed based on the value it created to the participants and out of the participants' economic self-interest.

7 DE4A Principles

The principles listed in this chapter aim to provide guidance in relation to the goals that the DE4A project should aim to achieve, by orienting all activities in the project related to design, realisation, future maintenance and support, governance, etc. of its results.

7.1 Sources and foundations of the DE4A principles

The principles listed in this chapter are based on and inspired from by existing legal provisions of the EU and from strategic documents, referring to eGovernment in particular and digitalisation in general, adopted in recent years by the EU Commission or the EU Member States.

The main sources are the:

- TEU: Consolidated versions of the Treaty on European Union and the Treaty on the functioning of the European Union (2008/C 115/01) [41]
- CFREU: Charter of Fundamental Rights of the European Union (2012/C 326/02) [6]
- eIDAS: Regulation (EU) 910/2014 of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC [15]
- GDPR: Regulation (EU) 2016/679 of the European Parliament and of the Council from of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) [22]
- SDGR: Regulation (EU) 2018/1724 of 2 October 2018 establishing a Single Digital Gateway to provide access to information, to procedures, and to assistance and problem-solving services and amending Regulation (EU) No 1024/2012 [37]
- eGov Action Plan: Communication from the Commission “EU eGovernment Action Plan 2016-2020 - Accelerating the digital transformation of government” (COM/2016/0179 final) [13]
- EIF: Communication from the Commission “European Interoperability Framework - Implementation Strategy” (COM/2017/0134 final) [16]
- Tallinn Declaration: Tallinn Ministerial Declaration on eGovernment from of 6th October, 2017 [35]

7.2 Two different types of principles

In this chapter, for the sake of clarity and precision, we distinguish between “‘Fundamental principles” and “‘Derived principles”.

Fundamental principles are principles that indicate which final goals and values we pursue and try to achieve. They deliver more an answer to the questions “Why?” and “What?”.

Derived principles are principles that are resulting from one or several fundamental principles and indicate which means, goals, paths or ways we pursue and try to achieve in order to reach our final goals and values, i.e. the fundamental principles. They deliver more an answer to the question “How?”.

7.3 Fundamental principles

7.3.1 Subsidiarity & Proportionality

The **subsidiarity** principle requires EU decisions to be taken as closely as possible to the citizen. In other words, the EU shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at EU level.

The **proportionality** principle limits EU actions to what is necessary to achieve the objectives of the Treaties.

In the general context of the DE4A project, these principles mean that the architecture and the approach chosen should rely mainly and as far as possible, on national, regional or local solutions. Solutions should only be implemented at EU level if this is unavoidable and if the objectives cannot be sufficiently achieved at Member States level and can be better achieved at EU level.

Main sources for this principle: TEU and EIF.

7.3.2 Sustainability

The **sustainability** principle requires that the architecture and the approach chosen should not only prove to achieve the requirements and to be working reliably in the context of the project pilots or during the first years where usage will be low and use cases limited. The architecture, the approach and the solutions chosen have to be designed in a way that they are sustainable, i.e. that they will be able to cope with the high and regular usage that is expected for the future. To achieve such a sustainability, not only the technical aspects have to be considered but also other relevant aspects like, for example, organisational considerations, governance or future maintenance and support.

Main sources for this principle: eGov Action Plan, EIF and Tallinn Declaration.

7.3.3 Openness

The **openness** principle requires DE4A to use, as far as possible and as long as the requirements are met, open standards or specifications and open source software. It also requires DE4A to provide the results and products of the project - as far as possible, relevant and useful - as open data, open standards or specifications and open source software.

Main sources for this principle: eGov Action Plan, EIF and Tallinn Declaration.

7.3.4 Transparency & Accountability

The **transparency** principle requires DE4A to design the architecture and the solutions in a way that the procedures, the data flows, the interactions, the respective responsibilities, the data providers and consumers, etc., are transparent, i.e. perfectly clear and communicated in an understandable manner.

The **accountability** principle requires to make it perfectly clear who is responsible for what and to provide among others for the rules and infrastructure, as far as DE4A is concerned, that ensure long-term preservation according to an appropriate preservation policy for the relevant records and information, and guarantee of no permanent or more than temporary storing of information or evidence that should not be preserved.

Main sources for this principle: eGov Action Plan, EIF, Tallinn Declaration and GDPR.

7.3.5 User centricity & User empowerment

The **user centricity** principle requires to put the user and his requirements and needs systematically and truly at the centre, and to design the architecture, the services and the solutions in a way that they guarantee, as far as feasible given the existing legal and organisational constraints, an optimal user experience and a maximum of usability, usefulness and user-friendliness.

User empowerment could be considered as being part of user centricity. True user empowerment places the user in a position where, for example:

- he can freely and transparently choose among several proposed options and channels those that suit him the best;
- he can rely on user-friendly and fast support and help if needed;
- he is involved, as much as possible and relevant, in the design of the services, as well as in regard to feedback on the quality and user-friendliness of the services proposed;

Main sources for this principle: EIF, Tallinn Declaration and SDGR.

7.3.6 Equality & Non-discrimination

The **equality and non-discrimination** principle requires that users have to be treated as equal and that any discrimination based on any ground such as sex, race, colour, ethnic or social origin, genetic features, language, religion or belief, political or any other opinion, membership of a national minority, property, birth, disability, age, sexual orientation, nationality or place of residence shall be prohibited.

Main sources for this principle: TEU, CFREU, and SDGR.

7.3.7 Security & Trustworthiness

The **security and trustworthiness** principle requires that the architecture and the solutions are designed and implemented in a perfectly secure way using state-of-the-art and interoperable (e.g. eIDAS) security approaches, services and building blocks.

Main sources for this principle: eIDAS, eGov Action Plan, EIF, Tallinn Declaration, and SDGR.

7.3.8 Data protection & Privacy

The **data protection** principle requires that outmost care and attention be reserved for protecting personal data from misuse or unauthorised, illegitimate access, and that the user has the possibility to manage (e.g. access, check and inquire about the use of, submit corrections to, authorize (re)use of) his personal data.

The **privacy** principle requires that the private life, the home and the communications of each citizen are respected and that no personal data are gathered without a legitimate reason and purpose.

Data protection and privacy should (as far as possible) be achieved by design, i.e. be embedded in the technical solutions and services in a way that misuse or illegitimate access is made impossible or at least very difficult through the technical approach itself, and without having to rely on organisational measures or solely on legal measures to guarantee the compliance.

Main sources for this principle: CFREU, GDPR, eIDAS, eGov Action Plan, EIF, Tallinn Declaration, and SDGR.

7.3.9 Effectiveness & Efficiency

The **effectiveness** principle requires that the solution or service really delivers the required result.

The **efficiency** principle requires that the required result is delivered as smoothly, as swiftly and as simply as possible.

Effectiveness and efficiency are in the interest of the user and of the public sector bodies providing services and procedures at the same time. Administrative simplification and reduction of administrative burden are implementations of this principle. Automation and proactive government are ways to achieve the end goal of efficiency.

Main sources for this principle: eGov Action Plan, EIF, and Tallinn Declaration.

7.4 Derived principles

7.4.1 Once-Only Principle (OOP)

Statement	Use cases, user journeys, service design and the solutions based on them have to be designed and realised in a way that they achieve - as far as feasible given the existing unescapable legal and organisational constraints and as long as no disproportionate burden is imposed on the public authorities - a maximum with

	regard to true implementation of the OOP, i.e. they have to reduce to the minimum the necessity for the user to provide evidence more than once in the context of the administrative procedures concerned.
Rationale	• Art. 14 of SDGR aims at achieving cross-border OOP. OOP is often best achieved by not simply reproducing existing business processes, but by rethinking completely and fundamentally the business process in the context of the new opportunities offered, i.e. business process reengineering (BPR) is often needed. • Implementation of OOP is a very powerful and elegant way to fulfil the end goals of User centricity & User empowerment as well as those of Effectiveness & Efficiency.
Implications	• Existing cross-border administrative procedures have to be re-analysed and reengineered in the light of OOP and the opportunities an OOP technical system could provide in order to design the services in a way to make them as user-centric and efficient as possible in the given context. • Often it is not enough to take into consideration one single administrative procedure. The administrative procedure has to be evaluated in the context of the complete user journey that could involve nowadays (before BPR) perhaps several administrative procedures that the user has to complete sequentially in order to achieve his final goal.
Derived from	• Principle of User centricity & User empowerment • Principle of Effectiveness & Efficiency

7.4.2 Digital by Default

Statement	Use cases, user journeys, service design and the solutions based on them have to be designed and realised in a way that they achieve - as far as feasible given the existing unescapable legal and organisational constraints - in a user-centric way a maximum of digitalisation. All administrative procedures should be offered - as much as possible and as long as it stays user-centric - fully online in a digital manner. This does not mean that the user should be obliged to use the online administrative procedure. He should always keep the possibility to use other non-digital channels. But he should usually have a right and an option to use a fully online digital procedure.
Rationale	• Art. 6 of SDGR foresees the obligation, for a long list of administrative procedures, to offer them fully online. • Implementation of Digital by Default is a very powerful and elegant way to fulfil the end goals of User centricity & User empowerment as well as those of Effectiveness & Efficiency.

	• The eGov Action Plan, EIF and the Tallinn Declaration contain "Digital by default" as a central strategic goal and principle.
Implications	• Often the best and most user-centric and efficient way to digitalise an administrative procedure is to automate it entirely (e.g. by implementing OOP or via proactive government). If such a complete automation takes place, then the administrative procedure as such in some way becomes invisible for the user and it certainly then makes no further sense to offer such a procedure as an online administrative procedure.
Derived from	• Principle of User centricity & User empowerment • Principle of Effectiveness & Efficiency

7.4.3 Inclusion & accessibility

Statement	All types of users should have the possibility to use the OOP technical system and the online procedures using this common technical system. The usage should, for example, be possible in a non-discriminatory way also for people with disabilities, for cross-border users that perhaps do not understand the official language(s) of a given Member StateMS, for users using a mobile phone or a smartphone, for users using less popular browsers (e.g. speech browsers, Braille readers) or for elderly people. Therefore, implemented solutions should in the context of DE4A and beyond, where relevant and necessary, be among others: • compliant to the web accessibility requirements, • be multi-channel in the sense that they can also be used via smartphones, tablets or other devices used to access online procedures, • be as multilingual as possible, at least to the extent to comply with the SDGR requirements, • be enabled for cross-border use.
Rationale	• Web accessibility is a legal obligation for all Member States according to the Directive (EU) 2016/2102 of 26 October 2016 on the accessibility of the websites and mobile applications of public sector bodies and for the EU Commission according to Art. 8 of SDGR. • The eGov Action Plan, EIF and the Tallinn Declaration contain "Inclusion & Accessibility" as a central strategic goal and principle. • Inclusion & accessibility are important means to fulfil the end goals of Equality & Non-discrimination and User centricity & User empowerment.

Implications	• Non-discrimination and true user centricity for the user
Derived from	• Principle of User centricity & User empowerment • Principle of Equality & Non-discrimination

7.4.4 Data control by the user

Statement	Natural persons should have control of their own personal data. To maximise the degree of control a user has over his personal data, in the context of DE4A use cases, user journeys, service design and the solutions based on them should be designed and realised in a way that they place as much as possible the user in the center. This can mean, for example, to give him the possibility to decide if he wants to use a specific evidence coming from an authentic source in a Member State to provide it to a competent authority in another Member State requesting such evidence. This certainly also means that at all stages, a maximum of transparency has to be achieved in regard to the personal data stored and exchanged as well to the respective competent authorities.
Rationale	• GDPR insists in several of its recitals on the importance of data control by the user. • Data control by the user allows the cross-border use of the OOP technical system in full compliance with GDPR without having to create - at least for most of the online procedures and for those Art. 14 of SDGR is aiming at first – complex new mechanisms and tools (e.g. a central registry of competent authorities that would have the right to request for specific evidence might not be needed). • Data control by the user is a very powerful and elegant way to fulfil the end goals of Data protection & Privacy.
Implications	• A huge gain in efficiency and a very significant simplification of the architecture of the OOP technical system for most of the online procedures and the most urgent ones by eliminating unnecessary complex components and many legal risks and uncertainties linked to data protection • A maximum of transparency for the user
Derived from	• Principle of Transparency & Accountability • Principle of User centricity & User empowerment • Principle of Data protection & Privacy • Principle of Effectiveness & Efficiency

7.4.5 Only exchange of structured and authentic evidence that can be automatically and reliably be linked to the right person

Statement	The automated exchange of evidence aimed at in Art. 14 of SDGR takes place for authentic, i.e. lawfully issued, evidence that allows for automated exchange. Allowing for automated exchange means that the data in electronic format must be structured in such a way that it allows for machine-to-machine exchange of the data, or automated processing without any human intervention. In order to allow for such an automated exchange, it has also to be possible to match automatically and reliably the eID of the user to the correct unique identifier of this user in the authentic sources providing the evidence. Only if such a match already exists (for example via a previous manual onboarding process of the eID of the user), the OOP technical system can be used for an automated exchange of structured and authentic evidence.
Rationale	• Art. 14 of SDGR only mandates the automated exchange of lawfully issued electronic evidence that allows automated exchange. • In order to be reusable for other public authorities, evidence has to be considered as authentic by the evidence providing competent authority. • In order to allow for automated exchange, evidence has to be structured. • In order to allow for automated exchange, it has to be possible to match automatically and reliably the used eID with the unique identifier used in the authentic sources.
Implications	• Semantic and technical interoperability is required on attribute (metadata) and criteria (conditions to be fulfilled) level.
Derived from	• Principle of Effectiveness & Efficiency • Principle of Openness • Principle of Transparency & Accountability

7.4.6 Data minimisation

Statement	Only the data or documents that are specifically required for the procedure by the requesting competent authority are transferred.
Rationale	The general principle of data minimisation laid down in GPPR and in § 8 of Art. 14 of SDGR has to be complied to. This principle aims at minimising the risk of data misuse and to achieve the aim of protecting the personal data of the user.

Implications	• Semantic and technical interoperability is required on attribute (metadata) and criteria (conditions to be fulfilled) level. • The amount and nature of the data or documents that are transferred is determined by the requirements defined by the requesting competent authority for the purpose of the procedure for which the evidence is exchanged.
Derived from	• Principle of Data protection & Privacy • Principle of Effectiveness & Efficiency • Principle of User centricity & User empowerment

7.4.7 Federated, largely decentral OOP technical system

Statement	The OOP technical system for exchange of evidence functions essentially as a decentral federation of IT systems, building blocks, specifications, standards, etc. managed by the Member States with as few as possible central components (on technical, organisational, governance level) as possible.
Rationale	• The subsidiarity principle requires that the EU should act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at EU level. Therefore components should only be managed at EU level if this is unavoidable or if the objectives and requirements of the project cannot be met otherwise. • The sustainability principle requires to establish as simple and streamlined solutions as possible and not to create new management or governance levels if this is not absolutely necessary and helpful. Each new European central component causes sustainability problems on technical, organisational, governance, maintenance and support level for which new organisational structures or responsibilities have to be defined, hence increasing the general complexity and making the management of the OOP technical system more difficult and more burdensome. • The efficiency principle requires not to create unnecessarily new complexity in regard to governance, organisation or technical infrastructures.
Implications	• The technical system strongly relies on common reusable standards, specifications and building blocks. • Adding new participant to the technical system should not lead to a more than linear increase of the complexity and, hence, cost for any central function in the system, as this would create, by design, a limit to the its growth. • Extension to private sector participants and use cases is easily possible.

Derived from	• Principle of Subsidiarity • Principle of Sustainability • Principle of Effectiveness & Efficiency

7.4.8 OOP technical system: an ecosystem relying essentially on open standards, specifications and reusable building blocks

Statement	The OOP technical system is established as a collection of open and published standards, specifications and building blocks that allow for multiple and diverse technical solutions in the Member States - tailored to the respective, specific needs of the Member States and/or public authorities - to co-exist in the OOP ecosystem.
Rationale	The pre-existing ICT solutions and approaches in the different Member States and at the different competent authorities will require different tailored technical solutions interacting in an interoperable manner in order to achieve cross-border OOP.
Implications	• An ecosystem or market of solution providers, both public and private, can develop for the competent authorities to choose from. • Solutions and even installations can be shared by competent authorities with similar requirements, both within a single Member State, as well as cross-border. • Adoption of OOP is not restricted to cross-border transfers, but the ecosystem can also cover transfers between competent authorities on national level.
Derived from	• Principle of Openness • Principle of Subsidiarity • Principle of Sustainability • Principle of Effectiveness & Efficiency

7.4.9 Authentic sources under the sole control and responsibility of the competent evidence providing authority

Statement	Authentic sources stay under the sole control and responsibility of the competent authority providing the evidence. The evidence in the authentic sources remains the only authentic evidence and no copy of the authentic sources (reference register or reference database) as a whole should occur. Only individual copies of each specific, individual evidence requested in the context of a specific online procedure will be stored as records by the evidence requesting competent authority.

Rationale	Replicated data can deviate from the original source over time. The competent authority responsible for the authentic sources must be able to guarantee its authenticity at any time, which would not be possible anymore if a second replicated register or database out of the control of the original competent authority would exist.
Implications	• Evidence needs to be requested and transferred again specifically for each new separate procedure. • If a procedure at the requesting competent authority requires several pieces of evidence owned by different competent authorities, several individual and separate requests and transfers are required.
Derived from	• Principle of Subsidiarity • Principle of Sustainability • Principle of Transparency & Accountability • Principle of Data Protection & Privacy • Principle of Effectiveness & Efficiency

7.4.10 Flexibility and ability to evolve and adapt easily to new needs and technologies

Statement	The OOP technical system has to be designed and implemented in a way that allows for the necessary flexibility and for needed evolutions and adaptations later on.
Rationale	The results and products of DE4A have to fit in an evolving landscape of already existing building blocks (e.g. CEF) or IT systems, of building blocks or IT systems that are work in progress for the moment (e.g. EBSI), and of future building blocks or IT systems that will use innovative technologies we are perhaps not even aware of.
Implications	• The design of the technical system must take the future integration of new innovative technologies into account. • The technical system must be flexible and include rules and governance allowing for the necessary evolutions and adaptations.
Derived from	• Principle of Sustainability • Principle of Effectiveness & Efficiency

7.4.11 Reuse before build

Statement	Reuse of existing building blocks, open source software, standards or specifications at EU (e.g.: CEF, ISA[2]) or Member State level is preferred to the development of new building blocks, software, standards or specifications each time this is possible and as long as the requirements are met.
Rationale	For reasons of efficiency and interoperability, it makes no sense to repeatedly re-invent the wheel.
Implications	• The nature of the work and the required skillsets for the implementation of the OOP technical system are to a large extent more those of a system integration project than those of a software development project.
Derived from	• Principle of Sustainability • Principle of Openness • Principle of Effectiveness & Efficiency

7.4.12 Interoperability

Statement	Interoperability of the results and products of the DE4A project has to be a central goal. The recommendations linked to interoperability are written down in all detail in the EIF and don't need to be repeated here in an exhaustive manner. "Reusability" and "Technological neutrality and data portability" are among the principles defined in the EIF. They have certainly also to be considered as important elements of interoperability in the context of the DE4A project.
Rationale	• Interoperability is a logical and necessary consequence of the general principles of Sustainability, Openness and Effectiveness & Efficiency. • Without interoperability, derived principles like 7.4.1, 7.4.7, 7.4.8, 7.4.10 or 7.4.11 cannot be achieved. • Without interoperability, the results and products of the DE4A project could not be easily reused and would not qualify as solid building blocks for a technical OOP system.
Implications	• The recommendations of the EIF have to be taken into account as far as possible and applicable.
Derived from	• Principle of Sustainability • Principle of Openness • Principle of Effectiveness & Efficiency

7.4.13 Mobile first

Statement	The products and results of the DE4A project should be adapted in the future to guarantee the sustainability of the project in a way that they can be used also easily via mobile devices in an easy manner and in a way that offers equivalent levels of user centricity and security for users of mobile devices compared to the usage via a traditional desktop PC.
Rationale	In many Member States, the number of users accessing information or procedures of public authorities is already higher for mobile devices than for desktop PCs. This number is constantly increasing and mobile usage is already or will be shortly everywhere the standard usage.
Implications	For future stages related to sustainability roadmap we foresee that: • The identification and, in general, the security solutions will have to be designed and realised in a way that allows them to work also on mobile devices. • The user interfaces will have to be designed and realised in a way that allows their usage on mobile devices, e.g. via responsive design solutions. • The different results and products will have to be designed and realised in a way that they can also be used by the native or hybrid mobile apps several Member States are already offering to their users for access to and usage of administrative information and procedures.
Derived from	• Principle of Sustainability • Principle of Openness • Principle of User centricity & User empowerment • Principle of Equality & Non-discrimination • Principle of Effectiveness & Efficiency

8 Once-Only Interaction Patterns

This chapter provides a preliminary description of the Once-Only interaction patterns that DE4 expects to investigate over the course of the project. The baseline assumption is that the entire interaction in these patterns will be fully supported by the Once-Only Technical System. The key terminology used in this chapter is defined in Annex A. It is expected that Annex A will be further expanded in the course of the project. In the context of DE4A, an interaction pattern is defined as follows:

An Interaction Pattern describes the structured exchange of evidence and related information between users (initially citizens and businesses), Data Consumers and Data Providers (initially competent authorities), potentially extending to private sector actors beyond the SDG context.

In the Architecture Delivery iteration, starting with the PSA for the first iteration of our pilots, the different interaction patterns will be detailed, using the metamodel proposed in chapter 4. In upcoming task, the different patterns, or, more precisely, their implementation and inclusion in the Once-Only Technical System, will be aligned with the Target Architecture time horizon.

8.1 Intermediation Pattern

The Intermediation Pattern is depicted in Figure 11 and is essentially equivalent to the current OOP Blueprint, discussed in the context of the SDG Implementation. It foresees a (collection of) central component(s) that function like an “Information Desk”. It provides routing information to parties that request it in order to make the direct exchange of Evidence between Data Provider (DP) and Data Consumer (DC) possible.

A user initiates a procedure, i.e. though a public service request. The DC has no knowledge to which DP the request for Evidence should be directed, nor what exactly to request, as the Evidence is defined differently in different MS. The DC, therefore, inquires the “Information Desk” where to ask and for which exact Evidence. The “Information Desk” acts as an intermediator and informs the DC where the Evidence can be obtained.

The DC requests the Evidence directly from the respective DP. The DP can again inquire the “Information Desk” if the DC is allowed to receive the Evidence. If not, the Evidence is not provided. Alternatively, the “Information Desk” may deny the DC the routing information in the first place if they are not allowed to request the Evidence.

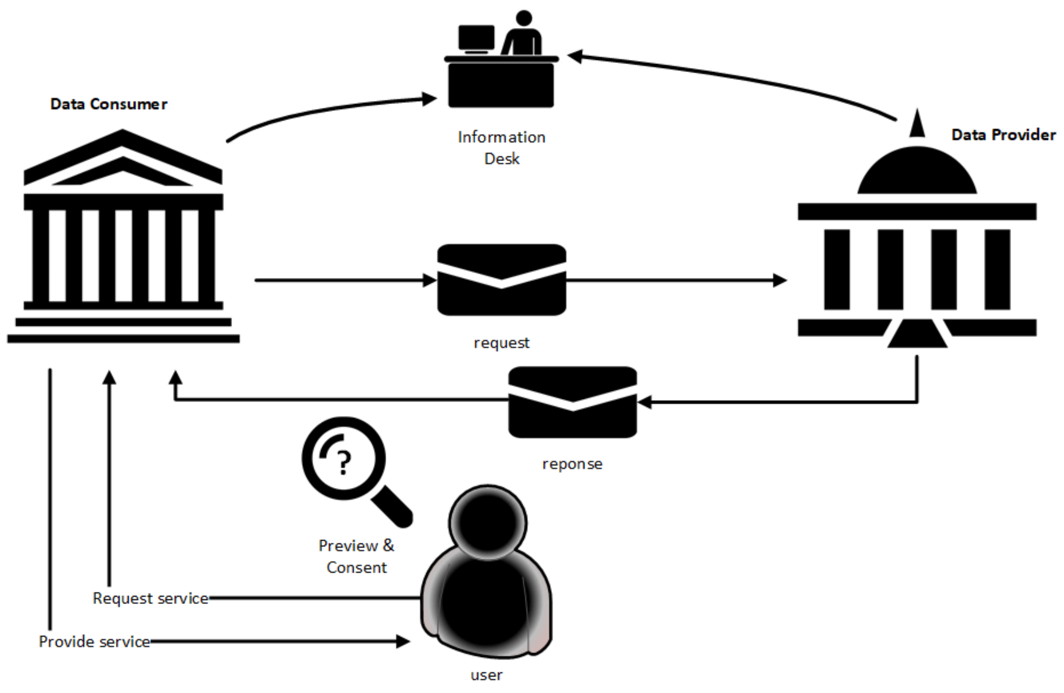

Figure 11: Illustration of the Intermediation Pattern.

The direct exchange of Evidence between DP and DC leaves open the question of a preview and an explicit consent by the user. The functionality to provide preview capabilities and giving consent can be implemented in different ways; The compliance of the different options with SDGR and GDPR is under discussion and topic of a forthcoming DE4A legal white-paper. The user can preview the Evidence and must give specific consent in order for the DC to receive it. The DC processes the Evidence and provides the public service to the user.

Note that mandates and proxies are possible, i.e. a legal person or natural person acting on behalf of another. This is a complicating factor that needs to be taken into account when elaborating the patterns.

8.2 Fully user-managed Access Pattern

Figure 12 illustrates this pattern, it basically boils down to providing the user with a system that supports him with an end-to-end system for obtaining the Evidence from DP and providing it to the DC.

A user initiates a procedure through a public service request. The DC points out what Evidence is needed for the requested public service. The user addresses the DP to obtain the Evidence electronically.

This pattern is applicable if it is clear to the users where to obtain the requested Evidence, otherwise they will have to do some research, i.e. by using the Your Europe search. In this fully user-managed pattern, it is the user who matches Evidence between MS, in other words, they translate the request from the DC to a request to the DP. This means that this pattern would be not OOP in the sense defined by Article 14 SDGR [37], however, it has clear advantages over paper-based evidence issuing or processing via e-mail and might be a good intermediate step for evidences not yet covered by SDG.

The underlying assumption is that the DPs expose their data services to the user. The user requests the Evidence(s) from the DP(s) and the DP responds with the Evidence. The user can inspect the Evidence and forward it to the DC, e.g. as hand-on to the public service webform. The Preview and

Consent are implicit in the hand-on of the Evidence. The DC processes the Evidence and provides the public service response to the user.

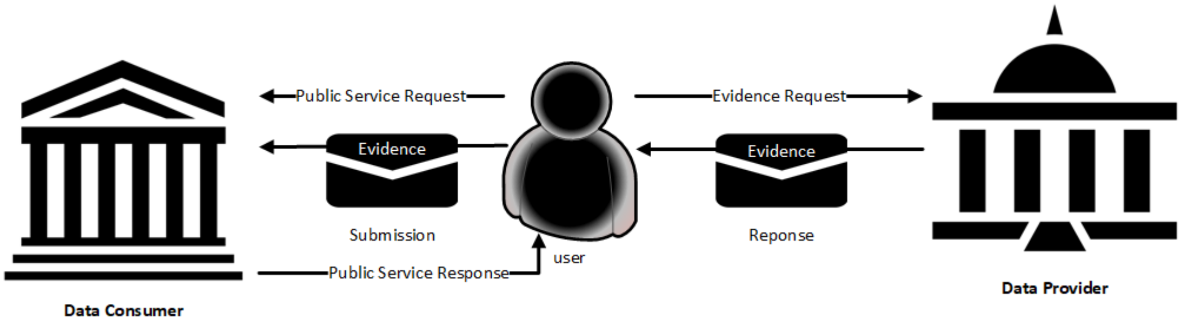

Figure 12: Illustration of the fully user-managed access.

Having the user manage the access to the Evidence directly solves two problems: First, preview and consent can be handled on the user controlled node. Second, the node controlled by the user provides a natural uncoupling point to handle problems of asynchronicity, especially if the Evidence response requires hours or even days. The sort of evidence will need to be considered in light of the risk that non-public information might leak via the user to participants that are not entitles to receive this information. Especially for citizen, the mere fact that the transfer is user-controlled does not mean that the user is able to fully exert this control, for example, for lack of knowledge, prudence or negotiation power vis-à-vis the requesting DC. This becomes especially relevant in the case of private sector DCs.

8.3 Supported User-managed Access Pattern

A variation of the user-managed access pattern is supporting the user with an Evidence Matching service as illustrated in Figure 13.

A user initiates a procedure, i.e. through a public service request. The DC requests Evidence from the user. It is not fully clear for the User from where to request which Evidence. The Evidence is available in the local language and structure of the MS of the DC or at a lower administrative level in the MS, e.g. municipality.

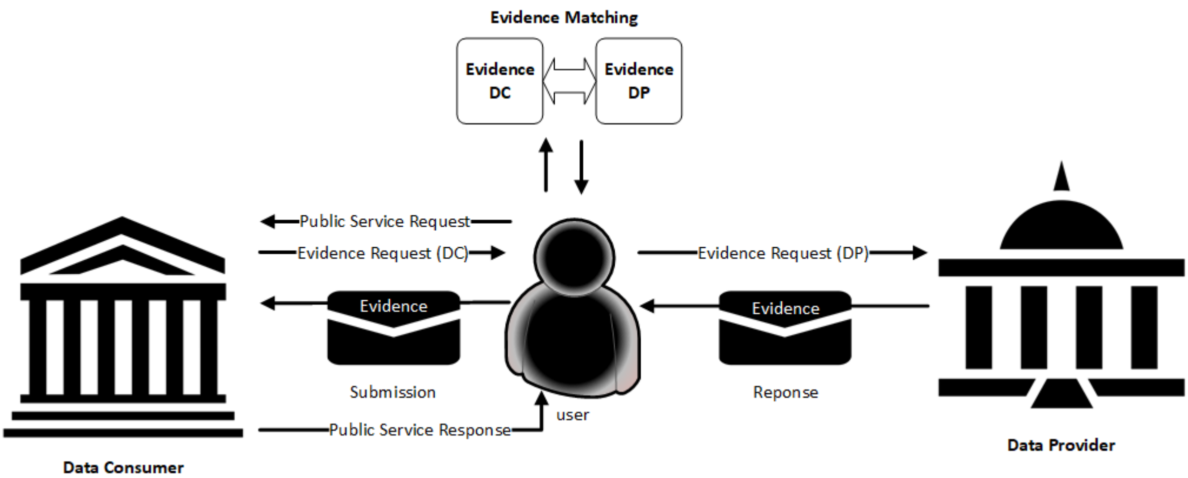

Figure 13: Illustration of the Supported User-managed Access – Evidence Matching.

A service, “Evidence Matching”, is provided to figure this out for the user, i.e., it does the translation (language + structure). Once it is clear where to obtain which Evidence the User requests it from the DP and the DP responds with the Evidence. The user forwards the Evidence to the DC. The Preview and Consent is again implicit as explained in section 8.2 above.

8.4 User-transferred Data Pattern

This pattern is depicted in Figure 14. It resembles the intermediation pattern depicted in Figure 11, but the transfer of the Evidence is managed by the user.

A user initiates a procedure, i.e. through a public service request. The DC does not know to which DP the request for Evidence should be directed. They, therefore, ask the “Information Desk” where to ask for the Evidence. The “Information Desk” acts as an intermediator and replies with the DP(s) where the evidence can be obtained.

The DC sends an Evidence request directly to the DP. Optionally, a check whether the DC is allowed the Evidence could be included. If not, the Evidence is not provided.

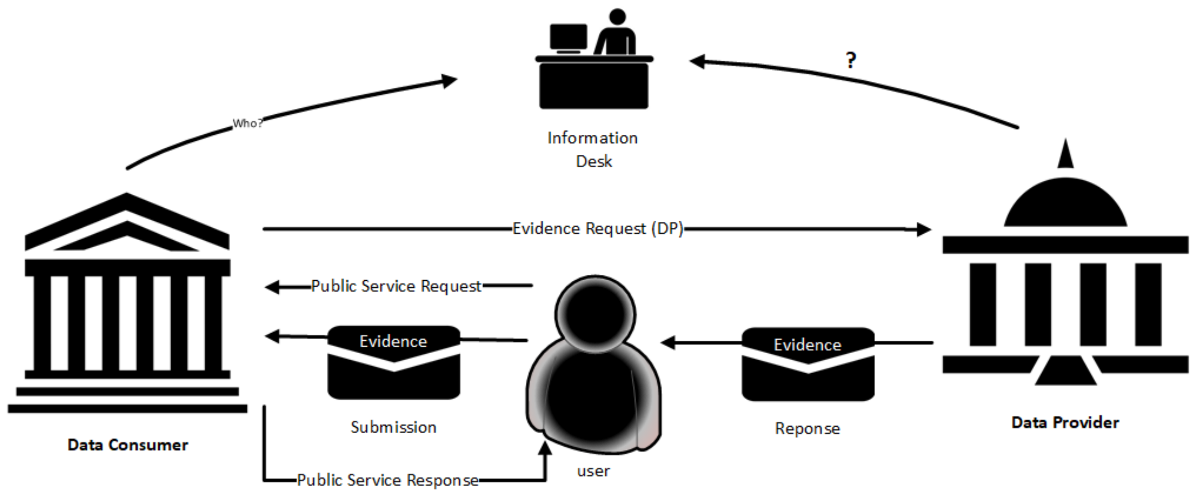

Figure 14: Illustration of the user- transferred data pattern.

If the Evidence is exchanged between DP and DC, it goes via the user. Preview of the Evidence and giving Consent is again implicit as explained in section 8.2 above. The user provides the Evidence to the DC, after which the public service is provided to the user.

8.5 Subscription and Notification Pattern

Figure 15 below depicts the Subscription and Notification pattern, which is dependent on a preceding, successful Evidence exchange, using any of the other patterns.

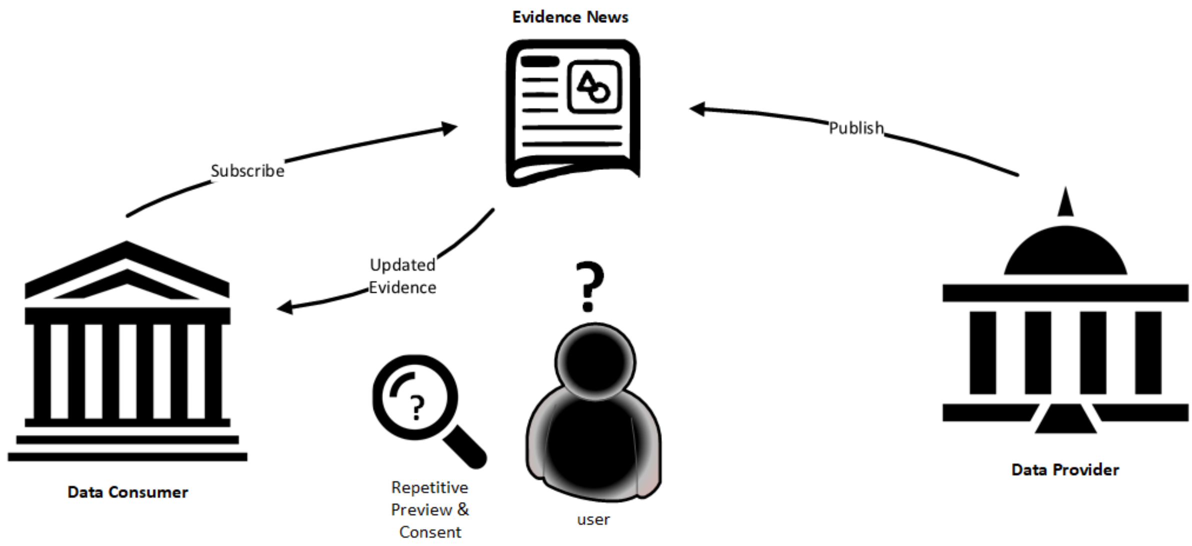

Figure 15: Illustration of the Subscription and Notification Pattern.

In the past, Evidence was provided to a DC with Consent of the user. The Subscription and Notification pattern is applicable if this specific type of Evidence might get updated over time and it is important for the DC to stay current.

The DC subscribes to Evidence updates and when the DP publishes an update of the Evidence in question, the DC automatically receives a notification of this event and the Evidence is provided to the DC.

An open question remains whether the user must give explicit Consent for each update ("repetitive" Consent) or whether this consent can/should be provided up-front with the initial Consent.

8.6 Lookup Pattern

The lookup pattern (see Figure 16) is considered for a specific purpose; Its main characteristic is online and near real-time (NRT) use of information. The information is simple, attributes based. This is only applicable in cases where the exchange has a legal basis and can be executed without explicit User consent.

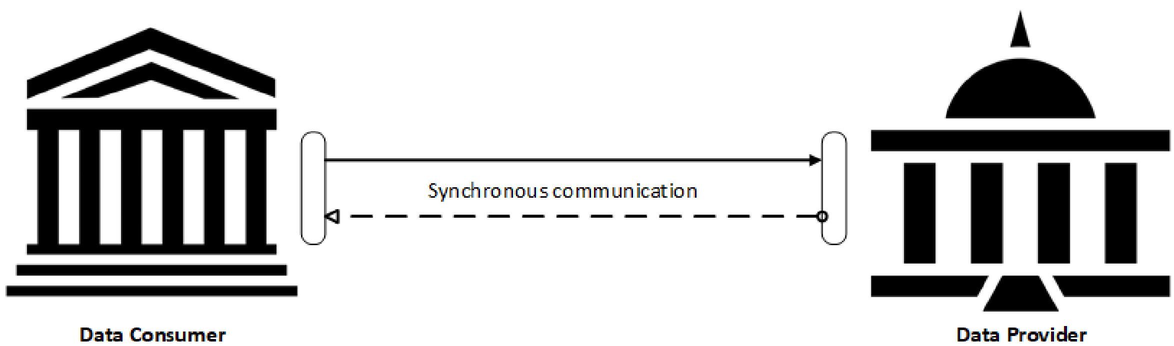

Figure 16: Lookup Pattern.

When the required information is not available right away, the process requiring the information stops and needs to be executed again from the start (as soon as the required information is available again).

This pattern requires synchronous communication, i.e. it must be "light weight". This pattern ties DP and DC closely together: the DC cannot provide its service in case the DP is not available. This means that DC and DP usually know each other up front and the communication relationship is set up to cover a large number of repetitive interactions over time.

8.7 Self-Sovereign Identity Pattern

The main feature of Self-Sovereign Identity (SSI) is that the data owner has alone and always full control of its data, even in the process, when data is presented to a data consumer [47].

Self-Sovereign Identity (SSI) pattern evolved from the Decentralized Identity Model, the occurrence of which was enabled by the rapid evolution of blockchain technology. Decentralized identity enables, unlike centralized or federated identity models, the options for two parties to establish a direct relationship between each other, without relying on any intermediary. Data is secured with public-private key cryptography, where each party owns its private key, which is usually generated by themselves directly without relying on any third party [47].

SSI benefits blockchain features by storing public keys or their identifiers (e.g., decentralized identifiers [45]) on a blockchain ledger to enable for anyone the verification of the digital signatures attached to the data. Data within the communication between the data owner and data consumer, is presented as a **verifiable credential** [46], which presents the proof about the real-world identity of a particular party. The verifiable credential is an essential SSI building block, which enables all physical credentials (e.g. identity document), based on cryptographic principles, to be presented and verified in the digital world. Such credentials are thus stored in a digital wallet [47].

Each credential includes a set of claims related to the subject of the credential. Those claims are made by an authority (issuer) and issued to the holder of the credential. The claim describes the state about a subject (e.g., attributes, relationships, etc.). The credential must be verifiable in terms, that anyone (i.e. verifier) can determine who issued the credential. Furthermore by verifying the credential, he/she can be sure that the credential was not altered since issuance, and that the credential is not expired or revoked [47].

Furthermore, the architecture of SSI enables real-world identities to be verified, without the need for any claim to be revealed to the verifier. This can be achieved with the advanced cryptographic mechanisms as Zero-Knowledge Proofs (ZKP). These mechanisms provide us with the possibility that any claim can be cryptographically verified, without the need to reveal any other additional information (e.g., other claims or its attributes) about the subject [48]. The procedure above related to SSI with ZKP is called "Selective disclosure".

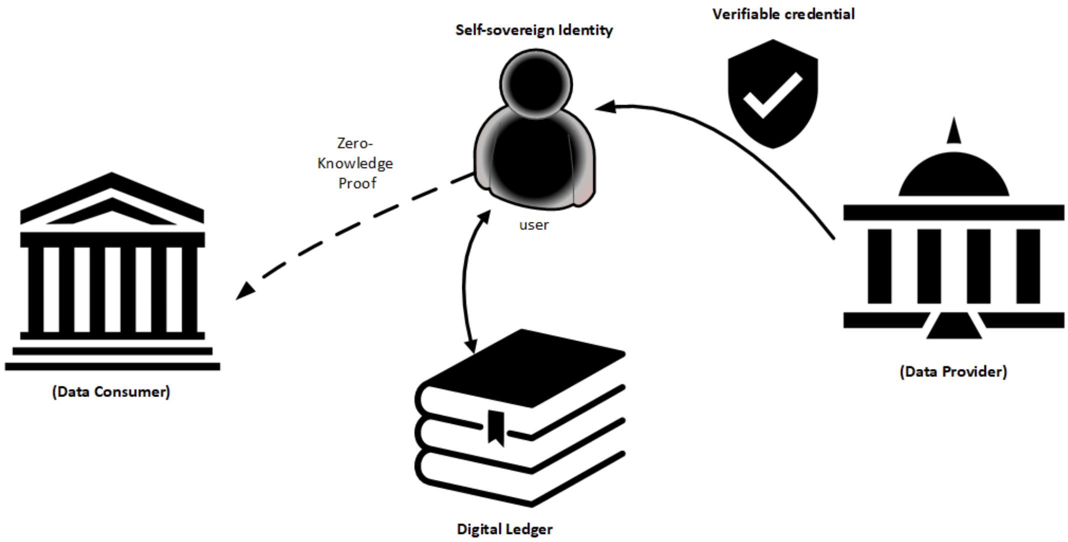

Figure 17: Self-Sovereign Identity Pattern.

Figure 17 illustrates an example of the SSI pattern. The example includes the issuing of a verifiable credential (e.g. Identity document) to an SSI owner (e.g. citizen) from some DP (e.g. Government). The example also includes the confirmation of a claim about a subject (e.g. that owner of a credential is over 18), defined in a verifiable credential to a DC (e.g. Public Service).

The citizen must create his own SSI and register its identifier with all relevant data (e.g. public key, etc.) to a blockchain ledger. He provides this identifier related to his SSI to a DP, to which he, with the help of PKC proves, that he owns a private key of that SSI. With this, he proves that the provided identifier truly implies his SSI. DP, after the standard procedures related to issuing of Identity documents, issues a digital version of an Identity document. The identity document is securely stored in his digital wallet. The verifiable credential can easily be verified by any party to which SSI owner provides it and is not publicly available. If the citizen has some businesses with a Public Service, where he needs to prove his claim (that he is over 18), he can use the principles of ZKP, and provide the Public Service with a mathematical proof about the claim, without the need, that to reveal his actual age. Furthermore, because of the SSI architecture, he can easily prove that the provided claim is actually the information from a verifiable credential, which is possessed by him.

9 Conclusions

The endeavour of implementing the Once-Only Principle across Europe gained considerable momentum through the inclusion of the Once-Only Technical System in the Single Digital Gateway Regulation. Different programs and projects resulted in an abundant choice of solution building blocks and solutions which makes the exercise to create the Once-Only Technical System a question of combining them in an intelligent and sustainable way.

In this document, we propose a set of principles (see chapter 7) and set out a long- term vision (see chapter 6) of a Digital Single Market Ecosystem to guide the development and evolution of the Once-Only Technical System through the five architecture time horizons described in chapter 5. We identified a set of Once-Only Interaction Patterns (see chapter 8) that we plan to investigate further in this project. In order to do so, we developed a metamodel (see chapter 4) including a number of design viewpoints that will serve as a tool in further detailing of identified patterns. We strive to keep the metamodel as simple and concise as possible and expect to extend it only very selectively during the architecture delivery iterations.

In line with the Architecture Process sketched in chapter 3, based on the TOGAF ADM, this document records the first two phases of the Architecture Development and is a fundament for the overall project, not only for the Architecture Delivery. As a consequence, this document is important to all other Work Packages, as listed below, and needs thorough review and discussion in the weeks and months ahead. It also means, that it is a living document and that this first version should not be understood as a normative text but as an invitation to comment and contribute both internally, within the DE4A project, as well as externally , for example in context of the CEF Preparatory Action and the SDG Coordination group.

Direct dependencies within this project are:

- The long-term vision should help to focus the work on D1.2 'Updated Member State eGovernment Baseline' towards identifying alignment and misalignment of national strategies.
- The OOP interaction patterns could form a basis for the extension and update of D1.4 'Updated Member State Once Only and data strategy Baseline' MS baseline both in terms of similarity with national solutions as well as the integration with them.
- In setting up the D3.3 'Semantic framework Initial version', WP3 'Semantic Interoperability Solutions' should adopt the proposed metamodel and work closely together with WP2 'Architecture Vision and Framework' in defining semantic (application) services, aligned with EIRA.
- The interrelation with WP4 'Cross-border Pilots for Citizens and Business and Evaluation' is manifold. Based on the metamodel and the requirements from D4.1 'Studying Abroad -Use cases definition and requirements', D4.5 'Doing Business Abroad- Use cases definition and requirements' and D4.9 'Moving Abroad – Use cases definition and requirements', WP2 will collaborate closely with WP4 Evaluation in detailing the Interaction Patterns and align them with the requirements and baseline architecture of the different use cases during the creation of the PSA and beyond, while closely supporting WP4 in modelling out their solution architectures.
- The close interrelation with WP4 will not stop there, as explained in the Architecture Process in sections 3.5 and 3.6.
- Architecture in the understanding of EIF, EIRA and in our understanding also covers questions of value, organisation and governance. The long-term vision and the principles set out in this document are input into the governance and sustainability models of WP6 'Sustainable Impact

and new governance models'. WP2 plans to cooperate with WP6 in setting up the methodological approach.

- Similarly, Architecture is related to WP7 'Legal and ethical compliance and consensus building' in the sense that principles and long-term vision challenge legal boundaries to interoperability and should add to the discussion of consensus building and policy recommendations.
- As stated above, the first version of this document is an invitation to comment and contribute, both internally and externally. In order to achieve this, the document should, once accepted as a deliverable, be analysed together with WP8 'Stakeholder dialogue, dissemination and communication' in order to identify dissemination products and activities.
- As mentioned, the Architecture Process outlined in chapter 3 is covering the overall project. It enriches the understanding of the interrelation between different activities on the overall project roadmap.

This large number of interrelations means that specific actions will be taken to align and effect these dependencies. Most notably, the alignment with the Pilots towards the next deliverable, which is also the next major milestone in the Architecture Work and will be reflected in 'D2.4 Project Start Architecture (PSA) first iteration', will be subsequently pursued.

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Annex A – Definition of Key Elements

This section summarizes definitions of key elements of the DE4A Architecture in development. This is an iterative process: only some elements are defined up front in the present version of the document. Consecutively, the elements identified in following WP2 tasks will be collected in this section and published in future versions of this deliverable.

Definitions are adopted as much as possible from relevant legal texts, i.e. SDG, the EIRA and prior work (i.e. TOOP), either directly or as specializations of these reference concepts. We use ArchiMate 3.1 as the basis of this exercise, in line with EIRA and the metamodel proposed in chapter 4. The order of the elements is analogous to chapter 4. If not specified here differently, the definitions of elements in ArchiMate 3.1 are applied.

1 Key Elements of the Business Layer

1.1 Key Business Roles

Business Role is a very important element in the DE4A Architecture, much more than Business Actor. The main reason behind this is, that Roles defined today might be very clearly be allocated to public authorities in t=2, but they might increasingly be also available for private sector Business Actors in t=3 and t=4.

A second reason for the reliance on roles is that in different implementation contexts, the assignment of actors to roles might differ. Consider, for example the specializations of Data Provider into Data Transferor and Data Owner, depicted in Figure 18 below. In some cases the same actor/organisation might be assigned both roles, while in other cases the intermediate service provider might be Data Service Provider in the context of the Once-Only Technical System for a larger number of Data Owners.

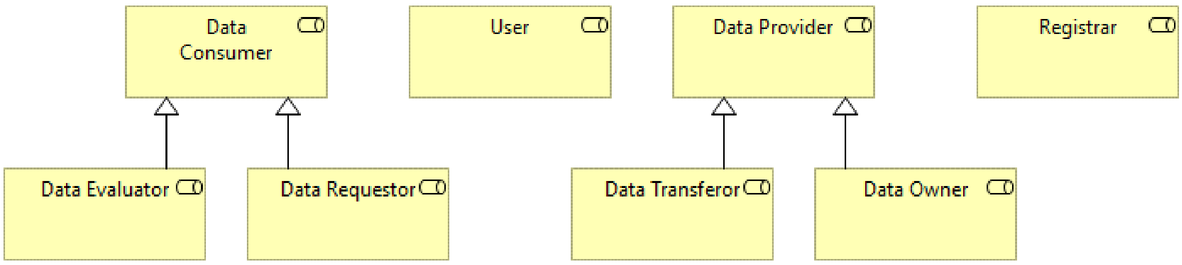

Figure 18: Overview of Key Roles.

1.1.1 User

For the time horizons t=2 and t=3 (see chapter 5), we adopt the definition of user from the SDGR article 3(1):

A 'user' means either 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.

This definition does not take the representation of mandate and proxy sufficiently into account, which will need more discussion and is expected to change the definition for the scope of DE4A in the future.

In the long term, 'user' might refer to any participant in the DSM.

1.1.2 Data Consumer (DC)

The organization/administration that is in demand of the Data in order to fulfil its mission to society or industry. [43]

DE4A adopts this definition; however, with a clearer focus on it being a role, in the sense that it is not the organisation, but the role played by the organisation that is in demand of Data.

The role played by an organization/administration that is in demand of the Data in order to fulfil its mission to society or industry.

In addition, we specialize this role into Data Evaluator and Data Requestor.

Data Evaluator (DE) is any organization authorized to receive and process data from the User (citizen or business), via the Once-Only Technical System. In t=2 this is the final Public Service Provider.

Data Requestor (DR) is the role-making search and request for data possible in terms of technology. If the Data Requestor is a separate entity, they carry out the request under the mandate of the Data Evaluator.

1.1.3 Data Provider (DP)

The legal entity that is in charge of the Data deployment. [43]

DE4A adopts this definition; however, with a clearer focus on it being a role played by an actor rather than the actor itself.
In addition, we specialize this role into Data Owner and Data Transferor:

Data Owner (DO) is any organization owning information about the User (citizens or businesses), a base registry or a secondary registry that might be necessary for another organization to exercise their competencies. It is responsible of authorization approval, data extraction and audit control.

Data Transferor (DT) is technically responsible for the actual data transmission. They operate the Data Service, exposing the data in the Once-Only Technical System. In some cases, Data Owner and Data Transferor are both the same actor/organisation, but they can also be different entities. The second is always the case when a national or sectoral intermediary is acting as an evidence broker.

1.1.4 Registrar

The role responsible of accepting and storing formal information according to predefined rules of law or governance.

In other words, these are organisations or persons that maintain a formal register of something. We expect to need registers for differing types of metadata to make the Once-Only Technical System work, e.g.:

- Competent authorities and the type and scope of application of their authority,
- Fact/Criterium/Claim/Credential that can be verified through an Evidence, their name, definition, accepted translation and potentially viable homonyms in the 21 languages of the Union, and
- Existing data services, its unique technical aspect and metadata required to activate/invoke the service.

1.2 Key Business Actors

1.2.1 Competent Authority

'Competent authority' means any Member State authority or body established at national, regional or local level with specific responsibilities relating to the information, procedures, assistance and problem-solving services covered by this Regulation; [37]

DE4A adopts this definition in the context of t=2. For time horizons beyond 12. December 2023, where we expect that the use of the Once-Only Technical System will grow beyond the scope of the SDGR, the definition is widened to mean any MS authority or body that has specific authority and responsibility ascribed by the law of the MS, and has access to or wishes to gain access to the Once-Only Technical System.

1.3 Key Business Objects

1.3.1 Evidence

The SDGR provides the following definition of evidence in Article 3(5):

'Evidence' means any document or data, including text or sound, visual or audio-visual recording, irrespective of the medium used, required by a competent authority to prove facts or compliance with procedural requirements referred to in point (b) of Article 2(2) [37].

Stripping away the expressions that pertain solely to the format, or essentially the stipulation that there is no legal format requirement, Evidence is defined as:

Any piece of information that proves facts or compliance with procedural requirements.

There are two aspects that we expect to play into the handling of evidence that we would like to add from an architectural point of view:

1. Current technological trends around blockchain (i.e. SSI) gave rise to the concept of verifiable claims and verifiable credentials. In order to accommodate this line of thought, verifying claims about facts is considered to be equivalent to proving facts; e.g.: proving the age of a person or verifying the claim of adulthood should both be considered relevant for the definition of evidence.
2. The level or required assertion may differ between use cases, as does the level of trust that different types of evidence can carry. Self-declaration, oath, certificate signed by the competent authority, data from or verification of claim by an authentic source carry different assurance levels, potentially even differing between different competent authorities and authentic sources.

Summing all up, we propose the following **working definition as basis for the DE4A Architecture**:

Evidence means any piece of information that verifies, claims, or proves facts or compliance with the procedural requirement to the appropriate level of assurance.

2 Key Elements of the Application Layer

2.1 Key Application Services

This section is intentionally left empty to not pre-empt discussions in the context of forthcoming tasks, based on the general requirements of DE4A MS generally and DE4A pilots specifically. The approach is to structure the document by the Application Services of EIRA (see: Technical - application view and Technical - infrastructure view [31]) and to define more specific application services identified in the context of OOP as specialization of these existing EIRA Application Services. This list of OOP Application Services will then be used as a basis/classification of the catalogue of SBBs in the Service Interoperability Toolbox.