Submitted to the EC on 31/03/2017

COMPETITIVENESS AND INNOVATION FRAMEWORK PROGRAMME
ICT Policy Support Programme (ICT PSP)

Project acronym: e-SENS
Project full title: Electronic Simple European Networked Services
ICT PSP call identifier: CIP-ICT-PSP-2012-6
ICT PSP main theme identifier: CIP-ICT-PSP-2012-6-4.1 Basic Cross Sector Services
Grant agreement n°: 325211

D6.7 e-SENS European Interoperability Reference Architecture

Deliverable Id :	6.7
Deliverable Name :	e-SENS EIRA n°4
Version :	1.0
Status :	Final
Dissemination Level :	Public
Due date of deliverable :	31.3.2017
Actual submission date :	
Work Package :	WP6
Organisation name of lead partner for this deliverable :	LIST
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Abstract:

This Deliverable contains a generic set of ICT Building Blocks, (e-SENS EIRA), that support the creation of cross border interoperability solutions. This 4th iteration (of 4) finalizes the description of the generic Building Blocks, including Life Cycle management and Deployment support for the Pilots.

History

Version	Date	Changes made	Modified by
0.1	25.10.2016	Initial version from D6.6	Eric Grandry
0.2	15.11.2016	Update section 4 and section 5	Eric Grandry
0.3	24.11.2016	Final catalogue of BBs	Eric Grandry
0.4	30.11.2016	Pilot vs. Domain Architecture	Eric Grandry
0.5	13.12.2016	Structure of the Repository	Eric Grandry
0.6	10.01.2017	BB & Product LC	Helder Aranha
0.7	13.03.2017	Review	Eric Grandry
0.8	14.03.2017	STORK-eIDAS Plugin	Siggi Masson
0.9	15.03.2017	TOOP Collaboration	Eric Grandry
0.10	15.03.2017	Integrate Yearly Reviews	Eric Grandry
0.11	16.03.2017	Update testing sections	Melis Ozgur Cetinkaya Demir
0.12	17.03.2017	NonRepudiation and EC	Massimiliano Massi
0.13	20.03.2017	Document Review	Herbert Leitold
0.14	21.03.2017	Review structure	Tanja Pavleska
0.15	21.03.2017	Full review	Eric Grandry
0.16	23.03.2017	Full review	Sander Fieten
0.17	28.03.2017	Final Review	Eric Grandry
1.0	28.03.2017	Final Review cross read	Christian Vindinge Rasmussen

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Deliverable 6.7 Contributors

Note: A detailed overview of the contributors of previous versions i.e. Deliverables D6.2, D6.3 and D6.6 can be found in Annex VI.

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Glossary

See: http://wiki.ds.unipi.gr/display/ESENS/Glossary

Executive Summary

The e-SENS project - Electronic Simple European Networked Services - focuses on strengthening the Single Market by facilitating public services across borders. The previous and on-going Large Scale Pilots (LSPs), STORK, PEPPOL, e-CODEX, SPOCS, epSOS, have already proven that the provision of electronic cross-border services is achievable and feasible. In numerous domains, technical building blocks have been developed and piloted, which enable seamless cross-border services respecting all the various challenges and requirements that were faced. e-SENS aims at consolidating and extending the work done by the previous Large Scale Pilots, Production maturing the ICT Building Blocks and extending their potential to new domains.

The e-SENS WP6 Building Block Provision aims to provide consolidated re-usable building blocks for the implementation of digital services in Europe, supporting the overall goal of e-SENS.

The objective of this deliverable is to present the final iteration of the e-SENS European Interoperability Reference Architecture (e-SENS EIRA).

The objective of the **e-SENS European Interoperability Reference Architecture (e-SENS EIRA)** is to provide an integrated solution for the project domain in terms of:

- Defining a coherent ICT Architecture for e-SENS interoperability;
- Containing or referencing generic and domain specific ICT interoperability Building Blocks (specifications and software) and related ICT Artefacts (guidelines, methodologies, whitepapers and reports); and
- Making e-SENS ICT Interoperability Building Blocks and related ICT Artefacts easily accessible.

The deliverable is composed of two parts: this report and the e-SENS EIRA electronic repository:

e-SENS EIRA : http://wiki.ds.unipi.gr/display/ESENS/

The report describes the Background, Structure and Use of the e-SENS EIRA and gives transparency into the work in WP6 Building Block Provision.

The e-SENS EIRA electronic repository provides access and analytical empowerment to a number of Solution Architecture Templates (SAT), Architecture Building Blocks (ABB), Specifications (SP, PR), Implementation Guidelines (IG) and Solution Building Blocks (SBB) that may be used in the WP5 pilots.

1 Introduction

1.1 Scope and Objective of Deliverable

The objective of this deliverable is to present the 4rd iteration of the e-SENS European Interoperability Reference Architecture.

This deliverable is the conclusion of the 4rd iteration of the e-SENS European Interoperability Reference Architecture (e-SENS EIRA). It is aligned with the milestones in the Technical Annex (TA) and **Milestone 6.9** in particular.

- **Milestone 6.1 (Month 4)** Business Modelling Consolidated
- **Milestone 6.2 (Month 6)** Inception phase ended
- **Milestone 6.3 (Month 18)** 1st iteration of the e-SENS EIRA
- **Milestone 6.4 (Month 24)** 2nd Iteration of e-SENS EIRA Construction phase ended
- Milestone 6.5 (Month ~~32~~ 46) e-SENS Architecture Evaluation
- Milestone 6.6 (Month ~~34~~ 48) Operational Transfer of Operation and Ownership phase ended
- Milestone 6.7 (Month ~~36~~ 48) Transfer consolidated i.e. finalizing e-SENS Transfer of Operation and Ownership including governance
- **Milestone 6.8 (Month 36)** 3rd Iteration of e-SENS EIRA
- **Milestone 6.9 (Month 48)** 4th Iteration of e-SENS EIRA

The objective of the **e-SENS European Interoperability Reference Architecture** is to create a repository:

- That contains a coherent ICT Architecture for e-SENS interoperability;
- That contains or references generic and domain specific ICT interoperability Building Blocks (specifications and software) and related ICT Artefacts (guidelines, methodologies, whitepapers and reports);
- That makes the e-SENS ICT Interoperability Building Blocks and related ICT Artefacts easily accessible;
- That is able to follow and adapt to the evolution of the systems it conceptually supports.

The objective of the **1st iteration** on the e-SENS EIRA (Deliverable 6.2 (M15)) was to:

- Create a coherent ICT architecture that supports the 1st wave pilots (Deliverable 5.2).
- Focus on the Business modelling, Requirements, Analysis and Design of Generic Building Blocks (Phases: Inception and Elaboration).
- Focus on Solution Architecture Templates and Architectural Building Blocks.
- Prioritize Building Blocks from the stock taking Deliverable 6.1.
- Align with the 1st wave pilots Building Block work through cooperation and transparency.

The objective of the **2nd iteration** on the e-SENS EIRA (Deliverable 6.3 (M24)) was to:

- Extend the ICT architecture to support the 2nd wave pilots and other cross border interoperability areas.
- Focus on Analysis and Design, Implementation, Test and Deployment (Phase: Construction)
- Support the implementation / deployment of 1st Wave Pilots.
- Map Building Blocks into the technical part of the e-SENS Maturity model
- Get an alignment with the 2nd wave pilots through cooperation and a transparency into the work on the Building Blocks.

The objective of the **3rd iteration** on the e-SENS EIRA (Deliverable 6.6 (M36)) was to:

- Use experiences from the pilots to mature a coherent ICT architecture.
- Support 1st and 2nd Wave Pilots in Implementation, Test, and Deployment
- Define and implement Life Cycle Management (LCM) i.e. incident-, change- and release management.

The objective of the **4th iteration** on the e-SENS EIRA (Deliverable 6.7 (M48)) is to:

- Use experiences from the pilots to finalize a coherent ICT architecture to be ready for transfer of ownership.
- Further support e-SENS Pilots in Implementation, Test and Deployment.
- Experiment and mature the Building Blocks Life Cycle Management to be ready for transfer of ownership
- Support other LSP Pilots e.g. STORK 2.0 in Deployment (Life Cycle Management).

The Target Audience of this deliverable is:

- Domain experts (in part) – to be able to understand the architectures at a high level.
    - See and review the link from Domain Requirements to Generic Requirements to Generic Building Blocks and back again to Domain specific solution architectures.
    - To contribute with legal and business insight to the discussion on Domain specific solution Architectures.
- ICT architects – to be able to understand the architectures in details.
    - See and review the Architectures from a technical perspective.
    - As Solution Architects, to be able to design and implement Domain specific solution Architectures from the Generic Building Blocks.

1.2 WP6 General Objectives and Vision

In the Technical Annex, the Goals of WP6 are:

- To facilitate the project goals of creating consolidated and extended solutions for cross border and cross domain pilot applications, by taking on board existing solutions and components from the participating LSPs and other relevant sources to create coherent, generalized and open components and specifications for solution implementation;
- To provide the building blocks according to the functional requirements of WP5 and support their deployment in the WP5 pilots;
- To move forward with the development of sustainable European Interoperability Architecture for cross sector services, by means of the provision of a set of building blocks and their underlying technical specifications, which will act as its foundation, in alignment with the work carried out in WP3.

The Work Package will focus on providing architecture driven solutions and Building Blocks (BB) that fulfil pilot requirement in the target domains. The Work Package will use state of the art technologies in close incorporation with pilot domains with the aim of creating generic ICT Building Blocks that can be profiled and reused in use cases in multiple domains.

1.3 Methodology of Work

The original WP6 activities had a clear development orientation, and they were organized in 4 Sub Group Competency Clusters (SGCC):

- SGCC1 eDelivery and e-Interaction;
- SGCC2 Semantics, Processes and Documents;
- SGCC3 Identity, Security and Trust;
- SGCC4 Conformance and Test.

This organisation of the WP6 was changed in July 2015 to adopt an operation's orientation with 2 SGCCs:

- SGCC A – Deployment (1.7.2015 – 31.3.2016): the objective of this sub-group is to strengthen the support and cooperation with the WP5 Domain pilots by institutionalize the deployment support and capture learnings in a structured way. This includes the continued work on a Conformance and Interoperability Test from SGCC 6.4 and offering of Conformance and Interoperability testing to the Pilots.
- SGCC B – Architecture (1.7.2015 – 31.3.2016): the objective of this sub-group is to finalize the development work of SGCC 6.1, 6.2, 6.3 (the descriptions of the SGCC 6.1, 6.2, 6.3 is inherited by SGCC 6.B) to create a coherent e-SENS EIRA that is aligned with ISA EIRA. This includes an evaluation of the Building Blocks to support the Transfer of ownership and operations to a sustainable organization.

1.4 Relations to Internal e-SENS Environment

The primary collaboration has been with WP5 - Piloting.

In the months 36-48 WP6 and WP5 have cooperated on aligning the following:

- Collectively collecting experience from Pilot's to improve usability of BB Description
- Maturation of Life Cycle Management
- Cooperation on Conformance and Interoperability testing

The cooperation with WP4 - Project Legal Expertise Centre, has been indirect through the Domain Pilot alignment with the work in WP4.

WP6 has provided input to WP3 - Sustainability and Long-Term Governance, on the Sustainability and Standardization assessment of Building Blocks (see deliverable 3.1 and 3.2). The results of the assessments have been used in the internal WP6 work to target technical maturity gaps and prioritise Building Blocks.

The cooperation with WP2 - Communication and Marketing, has increased in this iteration of the e-SENS EIRA, since the priorities and structure of Building Blocks now allow for better understanding of the Building Blocks, their context (i.e. pilots) and how they create added value.

1.5 Relations to External e-SENS Environment

In Deliverable 6.1, the external e-SENS Environment was the main contributor to an internal WP6 process of prioritization, maturity assessment and structuring of Building Blocks.

Deliverable 6.2 was the outcome of a process, where Building Blocks were prioritized, put into architectures, aligned with WP5 Pilots and matured. This gave a structured insight into the proposed Architectures and their directions. Deliverables 6.3, 6.6 and 6.7 (this final version) strengthened this structure and created a foundation for further cooperation with CEF, eIDAS, ISA, European Commission (DG CONNECT, DG DIGIT, DG MARKT), Member States and other Large Scale Projects. For WP6 especially the Cooperation with CEF and ISA has been prioritized. The cooperation with the EC Initiatives is described in section 5.

1.6 Quality Management

This deliverable has been developed in close cooperation with the QA team. The objective of the deliverable, and the structure (report and electronic EIRA repository) and objectives of parts of the deliverable have been discussed and decided with the QA team.

1.7 Risk Management

This section summarises how the risks for creating this set of architecture deliverables (and the final D6.7) have been managed: risk identification, risk analysis, risk assessment and risk mitigation (Table 1).

Description	Prob.	Imp.	Prio.	Mitigation	Owner
Deliverable contains too much information, making it difficult to apprehend and maintain	High	High	High	Separation of concerns: - Textual report - Structured Electronic Repository	Lead Architect
Architecture is not connected to pilots' reality (ivory tower syndrome)	High	High	High	Inclusion of experts from the pilot field; Integration of feedback from pilots; Actions to address yearly review comments	Lead Architect
Architecture is described with yet another formalism (reinvent-the-wheel syndrome)	High	High	High	Architecture framework relies on industrial standards Architecture description aligned with EC Initiatives	Lead Architect

Table 1: Risk Management

The yearly review comments have specifically been integrated along the iterations associated with this final deliverable (Table 2) in order to guarantee the alignment with the stakeholders' objectives.

Topic	Description	Action
Year 3		
Architecture and conformance testing activities should continue to be well coordinated and aligned with other related EU activities and projects		
1	Finalise architecture and engage CEF in securing the use of BBs for use in all domain	Section 5.3 - Cooperation with CEF on gap analysis and the prioritization and planning of maturing the e-SENS EIRA content Section 1.3 - Creation of SGCC 6.B – Architecture with the focus of finalizing the Architecture
2	Pay attention to issues at the operational production level	Section 4.1 - Rollout of product life cycle supported by issue tracking system
3	Compliance of MINDER testbed to other testbeds	Section 5.2.3 - Assessment of GITB compliance and implementation of recommendations
4	Accessing findings of pilots	Architecture Repository - Creation of a space dedicated to Pilots' feedback - Emerging BB integrated in EIRA Catalogue - Link to WP5 Pilot Assessment repository Deliverable D6.4 (EIRA Evaluation) - Feedback from pilots' through questionnaire
5	Interaction with CEF on management of transfer of ownership, properly identifying the consequences of its different types	Section 5.3.1 - Continuous architecture gap analysis Deliverable D6.5
Year 2		
WP6 to complete architecture and engage CEF in preparing BBs for use in other domains		
6	Architecture and conformance testing activities should be well coordinated and aligned with other related EU activities and projects	Section 7 - EC: Cooperation with CEF both on EIRA (gap analysis) and on testing - EC: Alignment with other related EU activities and projects Section 1.3 - Creating SGCC 6.A – Deployment with responsibility to institutionalize the learnings from the Pilots and hand over to SGCC 6.B
7	Step up work on technical assessment methodology, testing and compliance, support and maintenance	Deliverable D6.4 - Technical Maturity Model - Technical maturity assessment Section 4.3 - Testing activities - IOP and Conformance Testing Section 4.2 - EIRA Change Management

Topic	Description	Action
		- Support Process
8	Confirm the relationship between the e-SENS EIRA and the ISA architecture. Identify the differences (if any) with the ISA architecture and the possibility of a joint evolution towards the future.	Section 5.2.1 - e-SENS EIRA compatible and complementary to ISA-EIRA
9	Identify adaptations of and impacts on existing relevant BBs and the LSPs (recommended in the previous review report)	Section 5.1 - STORK 2.0 and eIDAS Integration Architecture
10	Complete architecture and engage CEF in preparing BBs for use in other domains of and impacts on existing relevant BBs and the LSPs	Section 3 + Architecture Repository Section 5.3.15.3.1 - Alignment meetings with CEF

Table 2: Yearly Reviews and Actions

1.8 Legal Issues

Legal issues have been identified in cooperation with WP5 and the pilots. The issues have been solved using WP4 expertise and input from previous Large Scale Projects.

1.9 Structure of the document

This Deliverable is divided into two parts: The first is a report that states the background of the e-SENS EIRA, and the second part is the repository of the e-SENS EIRA.

The report is structured in 4 main sections:

- **Methodology:** the methodology of work leading to the e-SENS EIRA is presented in chapter 2;
- **Architecture:** the Architecture Framework adopted in e-SENS and the e-SENS EIRA are described in chapter 3;
- **Deployment: t**he deployment support to Pilots incl. Conformance and Interoperability testing and life cycle management is described in chapter 4;
- **Alignment with EC**: the various activities required to maintain the alignment with the EC initiatives are described in chapter 5.

2 Methodology

WP6 uses an e-SENS version of the Unified Process (UP) methodology [1] where phases and tasks are mapped into the project environment. The Building Blocks (BB) are mapped into the UP model, where the phase placement i.e. Inception, Elaboration, Construction1, Construction2 and Transition, is dependent on the maturity of the BB.

All Building Blocks have been subject to the following process, where UP tasks: Business modelling, Requirements, Analysis & Design, Implementation, Test and Deployment have been used to structure the process for cooperation with WP5 (Figure 1). The type of task and amount of work that has been put into these tasks depends on the phase of the Building Block.

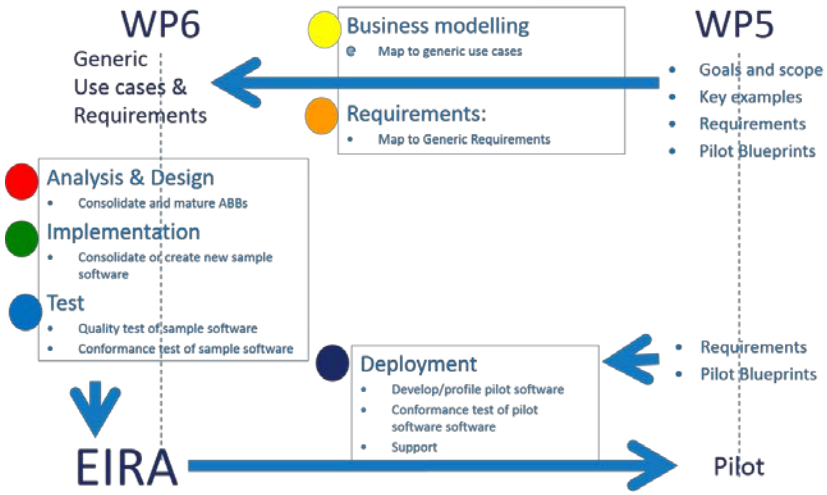

Figure 1: Mapping WP5-WP6 process to Unified Process

The **Business Modelling** and **Requirement** are tasks which are used in cooperation with WP5 domains to map and consolidate the WP5 use cases and requirements to generic use cases and requirements. WP6 is performing and has performed in cooperation with WP5 a requirements gathering in the different domains.

The **Analysis & Design, Implementation** and **Test** are WP6 tasks aimed at populating the e-SENS EIRA with Solution Architecture Templates (SAT), Architecture Building Blocks (ABB), Specifications, Implementation Guidelines, Solution Building Blocks (SBB) and other artefacts, which make it possible and easy to implement interoperability Solution Architectures in Pilots.

The tools for the above tasks were discussed in Deliverable 6.1, which was a stock taking of ICT Building Blocks from CIPA, Large Scale Projects and other EC projects in Member States; together with Generic Use cases and Requirements, this gave a good background for discussions, consensus building and prioritization of Building Blocks.

The generalized requirements together with the Building Blocks “on the table” have been discussed, analysed, structured, prioritized and used to create Target Architectures in the form of Solution Architecture Templates (SAT).

A major part of the work was carried out in Year 1 and Year 2 in Sub-Group Competency Clusters (SGCCs) and cross-SGCC Task Forces with clear development focus:

[1] http://en.wikipedia.org/wiki/Unified_Process

- SGCC 6.1: eDelivery and e-Interaction
- SGCC 6.2: Semantics, Processes and Documents
- SGCC 6.3: ID, Security and Trust
- SGCC 6.4: Conformance and Test

Deployment is the WP5 Pilot implementation of Solution Architecture Templates into Solution Architectures. The main task for WP6 is to support the WP5 process in creating Solution Architectures, software development, tests and transfer into operation. An organisation with processes that span WP5 and WP6 has been set up for this purpose.

A major part of this work was carried out in Year 3 and Year 4 in new Sub-Group Competency Clusters (SGCCs) and cross-SGCC Task Forces with focus on Life Cycle Management (LCM) and Support for Pilots:

- **SGCC 6.A: Deployment**: the objective of this sub-group is to strengthen the support and cooperation with the WP5 Domain pilots by institutionalize the deployment support and capture learnings in a structured way. This includes the continued work on a Conformance and Interoperability Test from SGCC 6.4 and offering of Conformance and Interoperability testing to the Pilots
- **SGCC 6.B: Architecture**: the objective is to finalize the development work of SGCC 6.1, 6.2, 6.3 (the descriptions of the SGCC 6.1, 6.2, 6.3 is inherited by SGCC 6.B) to create a coherent e-SENS EIRA that is aligned with ISA EIRA. This includes an evaluation of the Building Blocks to support the Transfer of ownership and operations to a sustainable organization

2.1 Business Modelling and Requirements

The initial phase of mapping between the use case and the generic requirements is the Business Modelling and Requirements phase (Figure 3). WP5 and WP6 have collaboratively created the e-SENS Requirement Modelling Methodology, which is briefly presented in this section.

Figure 2: Business Modelling and Requirements

The e-SENS Requirement Modelling Methodology is used in WP5 to guide the e-SENS Domains and their use case-specific work groups on how to capture goals and requirements relevant for a pilot scenario. The proposed method is an iterative process where the domain experts start by describing:

- goals and scope;
- key examples;
- requirements for BBs.

The work has been carried out using moderated workshops and the results and findings can be elaborated and further evolved in smaller task teams using the project's collaborative working tools for threaded discussions, or by employing additional online conference facilities.

The process is illustrated in Figure 3, and the results is documented in the so-called "Pilot Blueprint". The intention of the pilot blueprint is to provide a clear top-down description of the chosen pilot scenario. The "Pilot Blueprint" should offer a clear picture of the involved actors, and requirements for necessary BBs. The methodology is described in details in Deliverable 5.7.

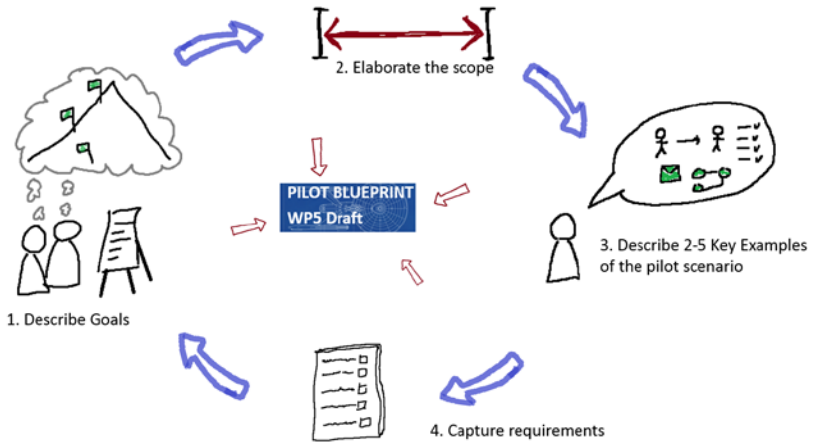

Figure 3: Overview of the requirements modelling methodology

The requirement methodology view on bridging and mapping the Pilot requirements into Generic requirements is shown in Figure 4.

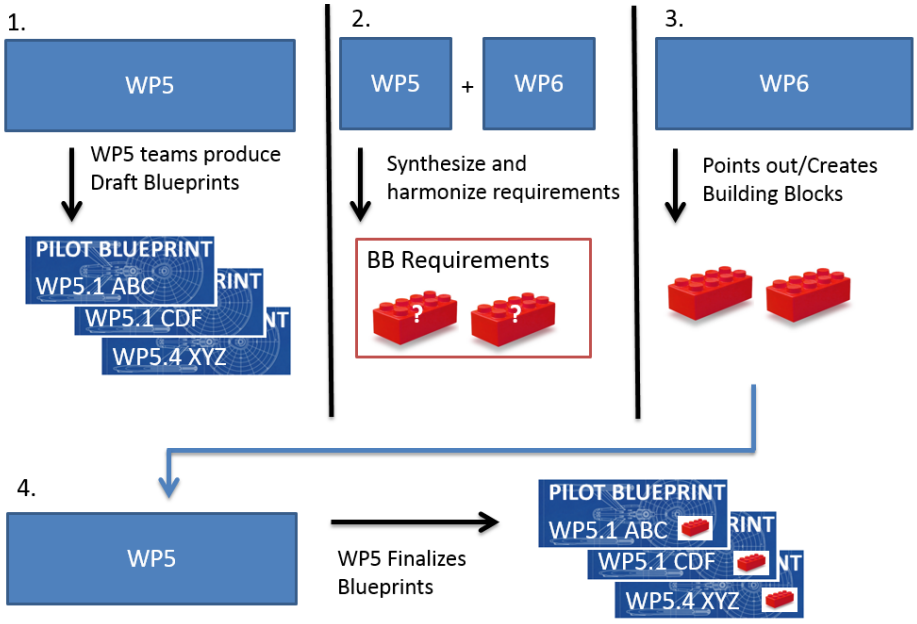

Figure 4: Cooperation of WP5-WP6 in the context of overall requirements modelling methodology

The Pilot blueprints (step 1) are used as a foundation for synthesizing and harmonizing the Pilot requirements into Generic requirements (step 2), that are categorized according to the *ISO/IEC 25010:2011 Systems and software engineering* framework and mapped into Building Block related Generic requirements. Step 2 corresponds to the Business Modelling and Requirement tasks in the UP as mapped into the e-SENS use in figure 2.

The requirements associated to each building block are structured according the description of Table 3.

Requirement ID	Requirement description	Source
R-*short name of BB-Type1**	*Clear and to the point description of the requirement*	*Should reference the source of the requirement e.g. from WP5 or SAT*
R-*short name of BB-Type2**		

Table 3: Requirements Description

**ID*

- *R=Requirement*
- *Short name of BB is 3 letters of the name(s) e.g. "Service Location" becomes "SerLoc"*
- *Type*
  - *P=Political – requirement coming from political issues e.g. interoperability legacy in domains*
  - *L=Legal – requirement coming from legal interoperability issues*
  - *B=Business – requirement coming from business value proposition perspective*
  - *S=Semantics – requirement to the semantics parts of the foundation architecture (can be derived from the P, L, B requirements)*
  - *T=Technical – requirement to the technical parts of the foundation architecture (can be derived from the P, L, B requirements)*

2.2 Analysis and Design, Implementation and Test

The business modelling and the requirements mapping provides the necessary input for the next phase to take place: the analysis and design, associated with the implementation and test of interoperable Solution Architectures in the Pilots (as shown in Figure 6). During this phase the e-SENS Repository is populated with the necessary artefacts.

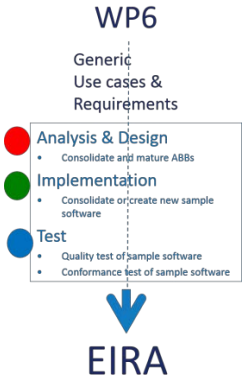

Figure 5: Analysis & Design, Implementation and Test

At the start of e-SENS (1.4.2013) the BBs had various degrees of maturity and had been developed with different focus, this meant that they were mapped into the UP development model at various phases (Inception, Elaboration, Construction1, Construction2). The methodology to **analyse and design** the BBs did vary, depending on the phase, resource availability and best practice. The SGCCs and Task Forces were given the freedom to choose what they considered to be the best approach for these tasks, usually opting for an agile approach e.g. Scrum based.

e-SENS has produced a minimal set of Software **implementation**, and did rely on external Software Providers i.e. other LSPs, CEF, CIPA, DGs, Open Source Software and off-the-shelf Software.

Since WP6 has only created a minimal set of software, there was no need to establish and implement a **software development testing** methodology within WP6. However, some specific tests are particularly relevant from the architecture perspective: the Conformance tests. Testing is further described in section 4.3.

The analysis, design, implementation and test tasks produce building blocks. These building blocks are part of the overall e-SENS Architecture, and are therefore incorporated in the e-SENS EIRA. The incorporation within the e-SENS EIRA is done according to the e-SENS Architecture framework, explained in the next chapter.

3 e-SENS EIRA

This chapter presents the main work product of the architecture capability: the e-SENS Reference Architecture (EIRA). The e-SENS EIRA is designed according to certain architecture principles and identifies the main Building Blocks selected in e-SENS. The Building Blocks are described along common dimensions, which are captured by the e-SENS Metamodel – the language used to describe them. All these concepts and their relationships are part of the overall e-SENS Architecture Framework, described in this chapter.

3.1 Basic vocabulary

The definitions of ICT architectural terms and concepts in e-SENS are based on vocabulary from the following sources:

e-SENS Baseline Architecture (Deliverable 6.1): Provides a foundation for work on an e-SENS Reference Architecture to support Solutions Architectures in the e-SENS domains. A repository of Architecture- and Solution Building Blocks collected through stocktaking from LSP projects (SPOCS, e-CODEX, EPSOS, PEPPOL and STORK) as well as other initiatives.

TOGAF9[2]: is an Enterprise Architecture Framework that is produced by The Open Group and is considered a de facto EA framework in Europe.

European Interoperability Framework (EIF[3]) and European Interoperability Architecture (EIA[4]): are a Framework and a Reference Architecture, created by EC (ISA) to facilitate interoperability and re-use when developing cross-border public services. It is based on the TOGAF9 framework.

The e-SENS Vocabulary can be found at: http://wiki.ds.unipi.gr/display/ESENS/Glossary

3.2 e-SENS Architecture Framework

According to ISO/IEC 42010[5], «an **architecture framework** establishes a common practice for creating, interpreting, analyzing and using architecture descriptions within a particular domain of application or stakeholder community».

The e-SENS Architecture Framework is specifically designed to create, understand and use the e-SENS Reference Architecture. It is made of the following concepts:

- the **e-SENS Metamodel**, which describes the **e-SENS Language** and integrates the **e-SENS Architecture Principles**;
- the **e-SENS Reference Architecture**, which conforms to the e-SENS Metamodel, and contains **e-SENS Building Blocks**; the Building Blocks are described according to the Metamodel;
- **e-SENS Architecture Viewpoints**, which are used to describe the e-SENS Reference Architecture

The e-SENS Architecture Framework is represented in Figure 6 and each of its elements is further detailed in the next sections of this chapter.

[2] http://www.opengroup.org/togaf/

[3] http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf

[4] http://ec.europa.eu/isa/actions/02-interoperability-architecture/2-1action_en.htm

[5] http://www.iso-architecture.org/ieee-1471/cm/

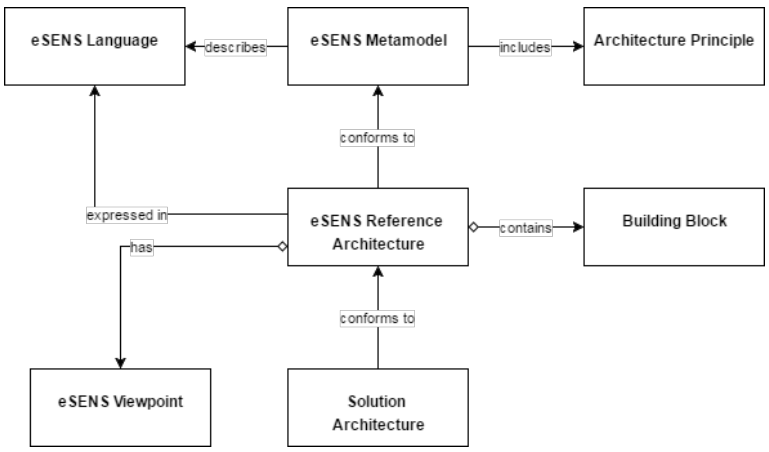

Figure 6: e-SENS Architecture Framework

It should be noted that the e-SENS Solution Architecture, developed by the pilot architects, is also related to the architecture framework:

- an e-SENS Solution Architecture conforms to the e-SENS Reference Architecture;
- an e-SENS Solution Architecture contains e-SENS Building Blocks.

3.3 Building Blocks

e-SENS adopts the TOGAF concepts of building blocks, and more specifically Architecture Building Block (ABB) and Solution Building Block (SBB). It also uses the concept of Solution Architecture Template introduced in ISA-EIRA, and adopts the ISA-EIRA model of these concepts, represented in Figure 7.

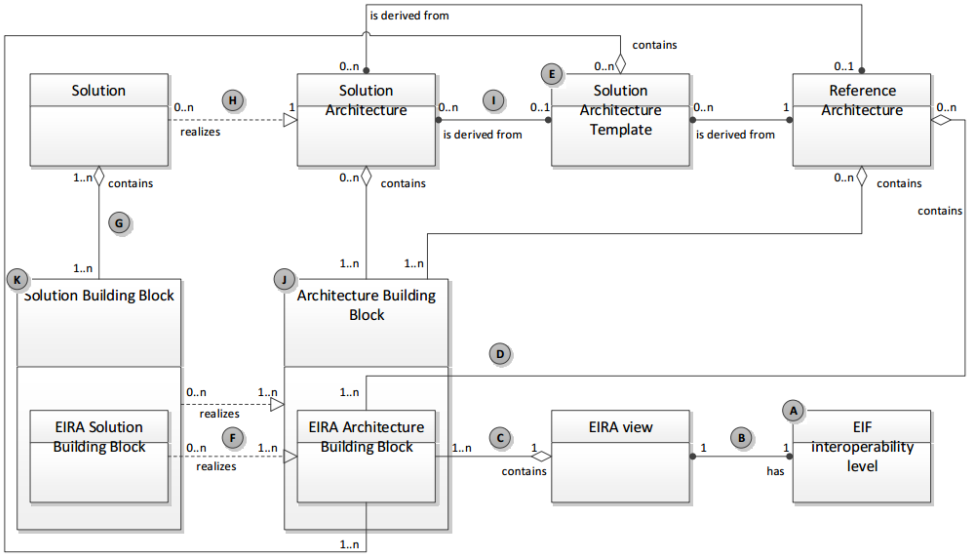

Figure 7: ISA BB Model (from ISA²)

Building blocks have generic characteristics as follows (TOGAF9 refined by e-SENS):

- It is a package of functionality defined to meet the business needs across a domain;
- It has a defined boundary and offers services that are generally recognizable by domain experts;

- It may interoperate with other, inter-dependent building blocks;
- It considers implementation and usage, and evolves to exploit technology and standards;
- It may be assembled from other building blocks;
- It may be a subassembly of other building blocks;
- It is re-usable and replaceable, and well specified.

In e-SENS, a **Building Block** can be of the following type:

- Architecture Building Block (TOGAF9)
- Solution Building Block (TOGAF9)
- Solution Architecture Template (ISA)

Architecture Building Block (ABB): it is an abstract component that captures architecture requirements and that directs and guides the development of solution building blocks through the adoption of technical specifications and implementation guidelines.

Solution Building Block (SBB): it is a concrete element that implements the required capabilities of one or more architecture building blocks. On the technical view, a solution building block is a sample Design and/or Software Component that is an implementation of (part of) an Architectural Building Block. A sample Design and/or Software Component is conformant to (part of) the ABB specification.

Solution Architecture Template (SAT): it is a sub-set of architecture building blocks (of the EIRA). Acting as a template for solutions (and their specific architectures), it guides the development of a certain kind of solutions (and their specific architectures).

3.4 Architecture Principles

The overarching Principles applied in the design of the e-SENS Architecture are taken from the European Interoperability framework v2.0 (EIF 2.0)[6]. Although most of these principles are dedicated to solution architectures, the Openness, Reusability and Technological neutrality[7] principles are specifically relevant to be included when designing the reference architecture. The e-SENS architecture is based on the Service Oriented Architecture (SOA) Paradigm[8], which has the potential, amongst others[9], to increase intrinsic Interoperability, increase reusability and increase vendor diversification options.

The components of the e-SENS Architecture are designed according to the principles of separation of concerns, high-cohesion and low-coupling, resulting in the following design guidelines:

- An ABB is a (collection of) **Capabilities** that are exposed to the architecture as **Services**;
- The services are defined through a **Service Contract** that contains the description of Business purpose and capability;

[6] The e-SENS architecture design was based on version 2.0 of the EIF; a new version of the EIF has been issued shortly before the finalization of the project, in which these principles are maintained and reinforced

[7] Although the open standards are actually defining specific technologies, the actual solutions implemented by the vendors are not bound to any specific technological platform

[8]Service Oriented Architecture: What Is SOA? SOA Definition team of The Open Group SOA Working Group 2014-11-05. Available from Internet: http://www.opengroup.org/soa/source-book/soa/soa.htm

[9]Thomas Erl. 2005. Service-Oriented Architecture: Concepts, Technology, and Design. Prentice Hall PTR, Upper Saddle River, NJ, USA.

- ABBs are designed to secure Service **Composability** i.e. that ABBs and their services can be composed with other ABBs and their services to provide interoperability solution;
- The **Coherence** of the architecture is secured by composing ABBs into templates for Interoperability Solution Architectures (SAT) i.e. higher level generic reference architectures;
- The SATs created are **Business related** through an abstraction of Business functionality and information and with a clear Business value.

The design of the e-SENS Architecture is constrained by the following Design standards (technical Annex):

- It is D&D (Development and Deployment) not R&D (Research and Development)
- Must be aligned with the ISA EIF, EIA and EIRA initiatives
- Based on Open standards and Open source technologies
- Create architectures that are generic and applicable in multiple domains
- Create Building Blocks, that are usable in the Pilots (Use Case driven)
- Create Building Blocks, that have pan-European usage
- Create Building Blocks, that can be sustained
- Reuse ICT Building Blocks from existing or former LSPs
- Reuse ICT Building Blocks from CIP projects (A and B)
- Reuse ICT Building Blocks from MS national solutions, where an ICT Building Block is scalable to pan-European usage
- Production ready i.e. Building Blocks are ready to be adapted in production settings
- Not mandating internal MS architectures

3.5 e-SENS Metamodel

The e-SENS Metamodel identifies the constructs required to describe the components of the e-SENS Reference Architecture, i.e. the Building Blocks. Defining a Metamodel has several benefits: share a common language; share a common definition of the elements of the architecture.

The e-SENS Metamodel focuses on the identification of the concepts required to describe the internals of the main components of the architecture, i.e. the Building Blocks. As the description of the Building Blocks is intended to serve the purpose of multiple stakeholders, the e-SENS Metamodel was collaboratively and iteratively designed. The following stakeholders have actively participated in the design process:

- BB Experts/Architects from WP6;
- Domain Experts/Architects from WP5;
- Sustainability Experts from WP3;
- CEF DSI Architects;

Additional comments/inputs have also been integrated from the following sources:

- Project reviewers;
- ISA EIRA

Two dedicated workshops were organised in the last year of the project to finalize the design and validation of the Metamodel. The consensus was built with the participating stakeholders, and the outcome was verified with instances of the various Building Blocks. Usage scenarios exploiting the designed models were also designed to validate the resulting Metamodel.

The final version of the e-SENS Metamodel is represented in Figure 8 and should be understood the following way:

- A Building Block provides Capabilities that are leveraged in cross-border (business and/or public) eServices. The Capabilities of Building Blocks are assembled in Business Processes to realize the eServices.
- A Capability represents the ability and capacity of the Building Block, which enables to achieve Generic Requirements (generic in the sense they are not specific to the domain of application). The couple Capability-Generic Requirement represents the **Intention** of the Building Block: what is intended to be achieved.
- A Capability is described in terms of Features it provides. Each Feature is specified with Technical Specifications. A Component is a logical grouping of related features: a Component implements the Technical Specifications associated with the Features it does support. The couple Feature-Technical Specifications represents the **Internal Specifications** of the Building Block: how the Capability is architecturally realized.

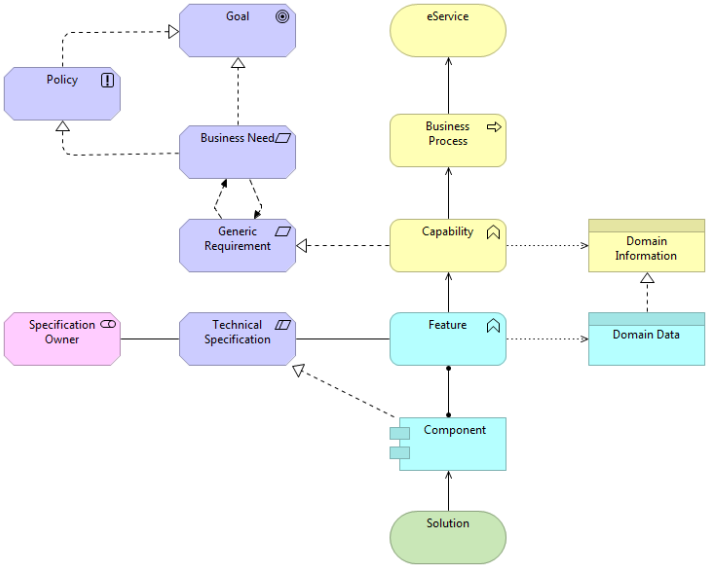

Figure 8: e-SENS Metamodel

Although the Capabilities, in the e-SENS context, are all technical capabilities of the Building Blocks (e.g. Message Exchange, Authentication Exchange), they are modelled as business elements: they indeed capture the business perspective of the Building Block.

The link between the different kinds of e-SENS Building Blocks and the Metamodel is represented in Figure 9 and should be understood the following way:

- ABB's are described from multiple perspectives:
    - Intention: Capability and associated Generic Requirements;
    - Specifications: set of supported Features and associated Technical Specifications; Component (when relevant);
- SBB's are described as Solution realizing the logical Component
- SAT's are described as Business Process assembling a set of ABB's (from a Capability perspective) in order to meet Business Needs.

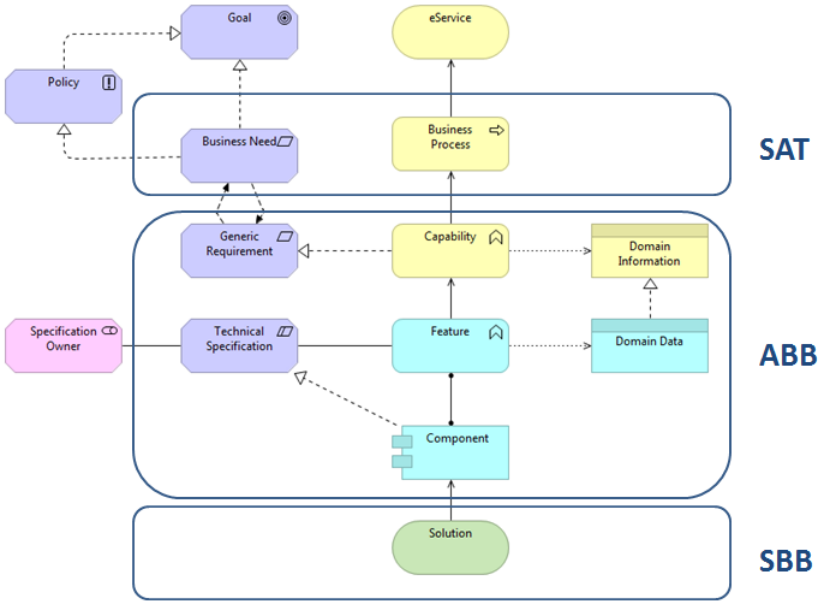

Figure 9: Metamodel and BB

The Metamodel not only defines the concepts required to describe the Building Blocks, but also introduces the context in which the Building Blocks reside, through links with additional concepts: Specification Owner, relating the BB's to the cloud of standardization organizations; Policy, relating the BB's to the legal context. Further extending the Metamodel can be envisaged in order to support additional contextual aspects without affecting the internal description of the Building Blocks.

The e-SENS Metamodel is expressed in the ArchiMate[10] modelling language, which choice is motivated by the following aspects:

- it is a lightweight and scalable language: its architecture framework is simple but comprehensive enough to provide a good structuring mechanism for architecture domains, layers, and aspects;
- it is an open standard developed and maintained by The Open Group: its evolution is closely aligned with the development of the TOGAF standard;
- it is supported by both commercial and open source model editors; the Archi open source tool is used in e-SENS.

The definition of each concept of the Metamodel, as well as its mapping to ArchiMate construct is detailed in annex xxx.

3.6 e-SENS Architecture Viewpoints

The e-SENS Reference Architecture is organised in viewpoints, according to ISO/IEC/IEEE 42010:2011[11]. Each e-SENS Architecture viewpoint is defined along the following dimensions: (i) Stakeholder: the target of the architecture view; (ii) Concerns: the concerns that the viewpoint cover;

The **eService Realization Viewpoint** is used to show how an eService uses the Capabilities of the Building Blocks (through Business Processes) to realize its finality. It provides a view on what Building Blocks are assembled/required in an eService. The viewpoint is defined in Table 4 and Figure 10.

[10] http://pubs.opengroup.org/architecture/archimate2-doc/

[11] http://www.iso-architecture.org/ieee-1471/cm/

eService Realization Viewpoint	
Stakeholders	Domain and application architects, portfolio managers, business analysts
Concerns	Added-value of capabilities, consistency and completeness
Layer	Business layer (application layer)
Aspects	Behaviour, active structure, passive structure

Table 4 - eService Realization Viewpoint

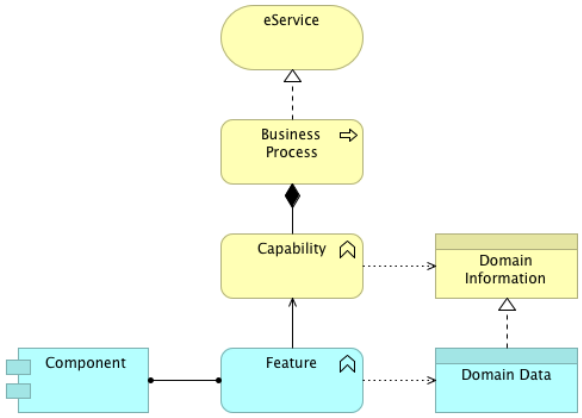

Figure 10 - eService Realization Viewpoint

The **Capability Realization Viewpoint** describes what features are used to realize a Building Block Capability. Its primary use is to support impact and gap analysis: what is the difference/overlap in terms of features of two similar capabilities. The viewpoint is defined in Table 5 and Figure 11.

Capability Realization Viewpoint	
Stakeholders	Domain and application architects, portfolio managers, business analysts, operational managers
Concerns	Consistency and completeness, reduction of complexity
Layer	Business and application layers
Aspects	Behaviour, active structure, passive structure

Table 5 - Capability Realization Viewpoint

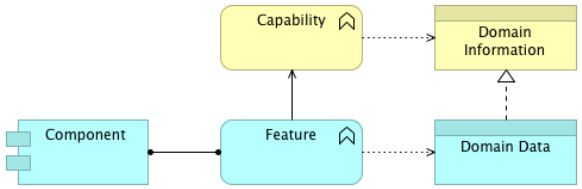

Figure 11: Capability Realization Viewpoint

The **Specification Realization viewpoint** allows the designer to model the realization of features specifications by the components and the association with its owner. It typically supports impact analysis in terms of specifications evolution, but also directs the software implementation of the component. The viewpoint is defined in Table 6 and Figure 12.

Specification Realization Viewpoint	
Stakeholders	ICT and application architects, portfolio managers, business analysts
Concerns	Relationships and dependencies between specifications and features, responsibilities, motivation
Layer	Motivation, and Application layers
Aspects	Motivation

Table 6 - Specification Realization Viewpoint

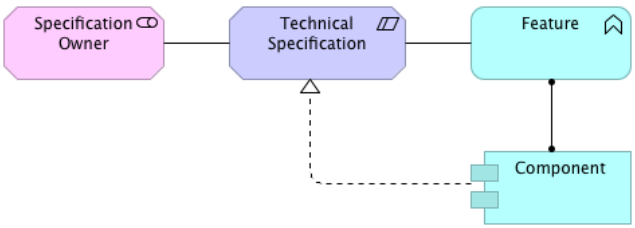

Figure 12: Specification Realization viewpoint

The **Requirement Realization viewpoint** allows the designer to model the realization of generic requirements by the Building Block capabilities, but also to relate the architecture requirements associated with Building Blocks to higher-level business needs and goals. It can be used to manage requirements traceability and coverage, but also to select required Building Blocks to meet specific business needs. The viewpoint is defined in Table 7 and Figure 13.

Requirement Realization Viewpoint	
Stakeholders	Organization and ICT architects, business analysts, requirements managers
Concerns	Architecture strategy and tactics, motivation
Layer	Motivation, and Business layers
Aspects	Motivation

Table 7- Requirement Realization Viewpoint

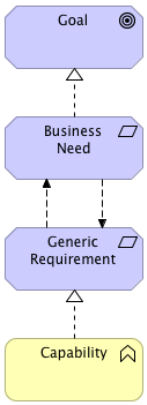

Figure 13 - Requirement Realization View

3.7 e-SENS Reference Architecture

The e-SENS Reference Architecture is composed of Building Blocks and conforms to the e-SENS Metamodel: every component of the Reference Architecture is described according the concepts of the Metamodel.

The reference architecture is designed in ArchiMate language, and maintained as an ArchiMate model in the Architecture Repository[12], which also provides a comprehensive description of each building block.

The Table 8 lists the Architecture Building Blocks of the e-SENS Reference Architecture, grouped per Solution Architecture Template. The Architecture Repository further describes each of these building blocks according the Metamodel, i.e. provided features, and associated technical specifications and technical components.

SAT	ABB Capability
eDelivery	Message Exchange
	Capability Lookup
	Service Location
	Backend Integration
eID	Authentication Exchange
	Attribute Provision
	Local Attribute Provision
eSignature	eSignature Creation
	eSignature Verification
	Federated Signing

[12] http://wiki.ds.unipi.gr/display/ESENS/

SAT	ABB Capability
eDocument	Document Provisioning
	Document Packaging
	Document Routing
	Document Annotation
	Business Rules Integration
Non Repudiation	Evidence Creation
	Policy Evaluation
	Evidence Storage
	Per-Hop-Protocol
Trust Establishment	PKI Trust Establishment
	Mutual Recognized Certificates Trust Establishment
	Trust Service List Trust Establishment
Semantics	Semantic Mapping Service
	Base Registry Identification and Access
	Core Vocabulary-Based Data Modelling
	Domain Specific Vocabulary Definition

Table 8: e-SENS Capabilities

3.8 e-SENS Architecture Repository

The architecture capability produces a large volume of various architectural work products, as illustrated in the previous sections. A common general practice to manage architectural work products is to introduce an architecture repository: a system that manages the data of an enterprise architecture, including data and process models and other enterprise information (TOGAF 9).

The e-SENS Architecture Repository is a TOGAF architecture repository: it allows the effective management of the various architectural work products issued during the architecture process.

The e-SENS Architecture Repository more specifically contains:

- the **e-SENS Metamodel** introduced in the previous chapter; from a governance and management perspective, the Metamodel identifies the manages entities, i.e. the entities that the architecture capability needs to manage;
- the **e-SENS Reference Architecture** introduced in the previous chapter; the set of ABBs are all stored in the e-SENS ABB Repository, for further use in solution development;
- the **e-SENS Specifications Library** which captures the various technical specifications and standards that have been adopted by e-SENS;
- the **e-SENS Reference Library**, containing the reference implementations that are provided by e-SENS for each ABB;
- a governance log, providing a record of governance activities: architecture decision (Decision Log), conformance assessment of the Solution Building Blocks against the related standard specifications, technical assessment of the Architecture Building Block;

The e-SENS Architecture Repository also maintains the relationships between the entities of the different repositories: an e-SENS Capability (in the e-SENS Reference Architecture Repository) requires

technical specifications (in the e-SENS Standard Library) and may be implemented with an SBB (in the e-SENS Reference Library).

The e-SENS Architecture Repository, as well as how the content relates to the e-SENS Metamodel is depicted in Figure 14. It is physically made of two systems: a wiki space containing the textual description of each component of the reference architecture, and a model repository containing the ArchiMate description of each building block.

e-SENS EIRA : http://wiki.ds.unipi.gr/display/ESENS/

e-SENS Model Repository : http://stash.ds.unipi.gr/projects/EIRA/repos/architecture-framework/

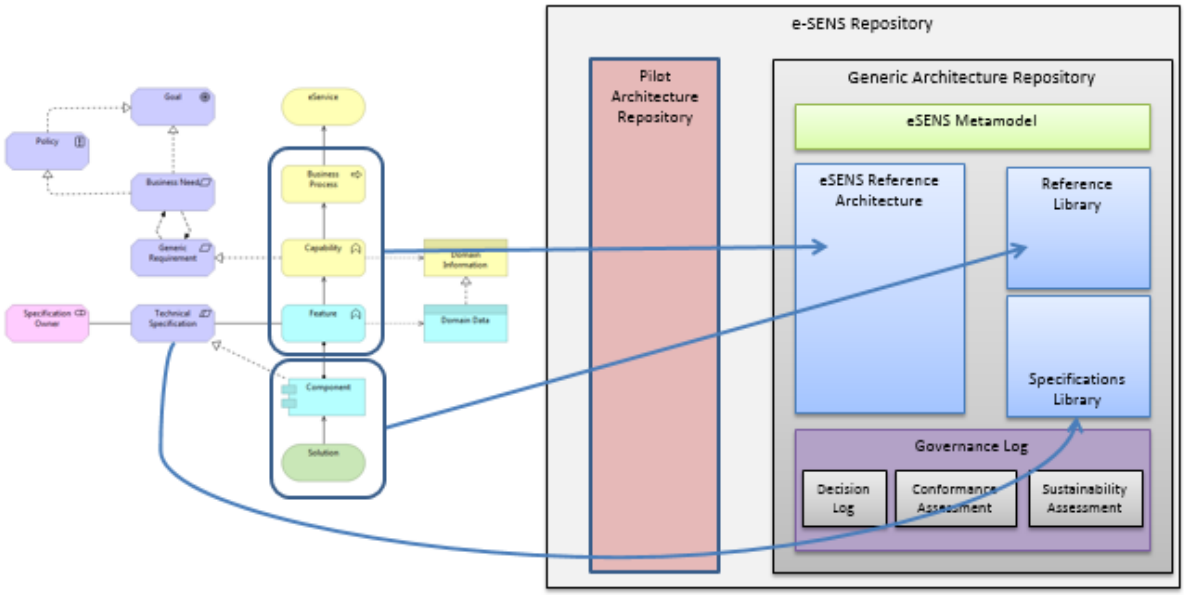

Figure 14: e-SENS Repository and Metamodel

The **e-SENS Reference Architecture** contains

- Asset description of ABB and SAT, as designed in e-SENS.

The **e-SENS Specifications Library** contains

- Profiles of standard technical specifications that have been adopted as specification of e-SENS Building Blocks;
- Technical specifications specifically developed in e-SENS (when the principle of standard cannot be applied).

The **e-SENS Reference Library** contains

- Asset description of SBB that implement the specifications of the e-SENS Building Blocks.

The elements of the repository stored on the wiki are all described according a common structure, presented in Annex II.

4 Deployment of Building Blocks

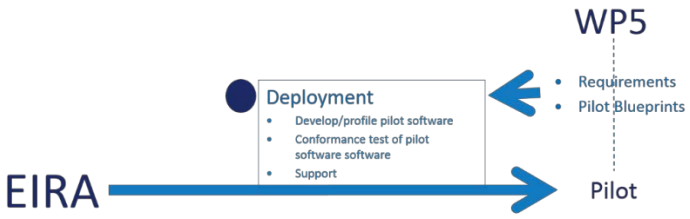

Figure 15: Deployment

The creation of an Interoperability Solution Architecture within a domain requires the deployment of generic Building Blocks into an implementation of domain usable Building Blocks. Coherent and consistent implementations across domains require support from WP6 to WP5 coordination between WP6 and WP5 as well as coordination across WP6.

After Pilot implementation and Pilot deployment there is a need for stability in terms of well-defined life cycle management of e-SENS EIRA Building Blocks.

4.1 Implementation Support

The support for WP6 deployment into WP5 Pilot implementation is performed through the BB-Pilot Board. Each Pilot will set up a BB-Pilot Board, which consists of a **BB Architect** per BB (SAT/ABB), a **Pilot Solution Architect** and a **Participant Solution Architect** per Pilot participant.

The **BB Architects** have the responsibility to

- Secure that BBs are implemented in a Solution Architecture in such a way that they are conformant to the generic BBs;
- Coordinate with other BB Architects to create a coherent Solution Architecture ;
- Support Solution Architects in designing a Solution Architecture;
- Coordinate with BB Architects in other Pilot implementation in such a way that consistent implementations of a BB is maintained across Pilots;
- Give feedback to WP6 on how maturity of BBs can be improved.

The **Pilot Solution Architects** have the responsibility to secure that the Pilot requirements are fulfilled in the overall Pilot Solution Architecture.

The **Participant Solution Architects** have the responsibility to design and implement the participants Pilot Solution.

Tools

- Telco and F2F meetings as needed, usually initiated by the Pilot
- Basecamp for discussions during Pilot implementation
- JIRA for tracking issues

Deployment support for pilots

- Support in Domain profiling the generic BBs
- Support in configuring the architectures
- Retrieve learnings from Pilots
- LCM of Building Blocks

- For transfer of ownership and operations, Integrate and handover LCM processes

Conformance and Interoperability testing

- Conformance- and interoperability testing of Pilot implemented Building Blocks;
- Offer conformance testing of CEF DSI eDelivery to external implementers of eDelivery incl. vendors;
- Finalize testing strategies .

4.2 Building Block & Product Life Cycle management

A new set of Life Cycle management (LCM) processes has been defined, with the aim of providing simplified processes, a better support to CEF, fostering user adoption and transparency to the Change Request process of EIRA. The new processes include e-SENS EIRA plus Minder & Kerkovi products currently in production. The processes were designed in the spirit of ISO 20000, as a set of IT services provided to a customer. In this case, the customers are the CEF and the e-SENS project.

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

4.2.1 Life Cycle Management Process

LCM services

The following IT LCM services are provided both to EIRA LCM and Minder & Kerkovi operations & LCM:

Service name	Meme	EIRA	Conformance & testing
Incident management	'Platform not behaving as expected'		X
Support management	'Please perform this with the platform'	X	X
Change management	'I'd like a new feature'	X	X
Release management	'When will changes be in production?'	X	X

Table 9: LCM services

Service design

The service design is summarized in Table 10.

Service	Internal outcomes	Customer outcomes
Incident management	Bugfix, changed config file/script	Incident resolved
Support Management	Task (work)	Report, info
Change management	Risk assessment, source code, deployable binary	Change acceptance/rejection

Release Management	Release plan	Binary production, EIRA updated, release notes

Table 10: Service Design

Service architecture

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

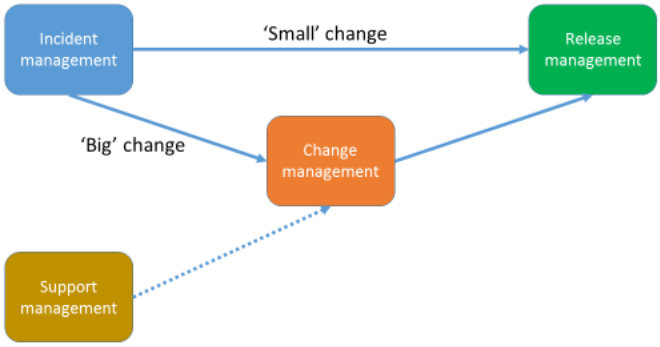

Figure 16: Service Architecture

Service strategy

The service strategy adopted is:

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

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

The workflows were agreed between both e-SENS stakeholders and the CEF, and have been quite stable. Only minor changes were requested by the CEF, not affecting the workflows *per se*.

EIRA and Minder/Kerkovi IT services as per Table 11 are reported and tracked on the JIRA platform provided by the e-SENS partner University of Piraeus:

Item	JIRA link
EIRA	http://jira.ds.unipi.gr/projects/EIRA/
Minder/Kerkovi	http://jira.ds.unipi.gr/projects/CONFTEST

Table 11: JIRA Projects

4.2.2 EIRA Life cycle management

Change management process - EIRA

The overall process for EIRA support includes the Lead Architect dispatching new opened issues to WP6 technical experts, which will do risk assessment and recommendation on change acceptance/rejection. The Architecture Board can be involved as Change Advisory Board (CAB) for complex changes. Typically, the experts discuss the matter as appropriate, in JIRA itself, and in case of favourable opinion propose a change by editing private, next-release document pages in the EIRA Wiki[13]. The Lead Architect then picks up the ticket and continues through the embedded Release Management process.

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

Figure 17 depicts the Change Management workflow. On the lower left corner, there is the complementing state-machine.

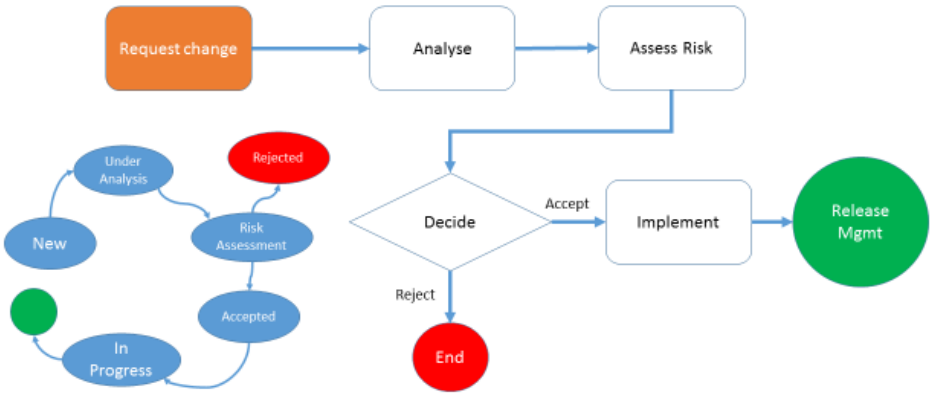

Figure 17: Change Management Process

Release management process – EIRA

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

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

Figure 18 depicts the Release Management process workflow. By embedding this process in Change Management, no further JIRA workflow is needed. The embedding translates into adding three more states in the end of IM and CM issues/tickets.

[13] http://wiki.ds.unipi.gr/display/ESENS/

Figure 18: Release Management Process

Support management process - EIRA

This process was designed to be very generic, in order to provide WP6 support besides change requests.

Basically the Lead Architect distributes the support request tickets to WP6 experts, who are expected to document discussions with the requester, peers, external organizations, etc., and ultimately fulfil the request.

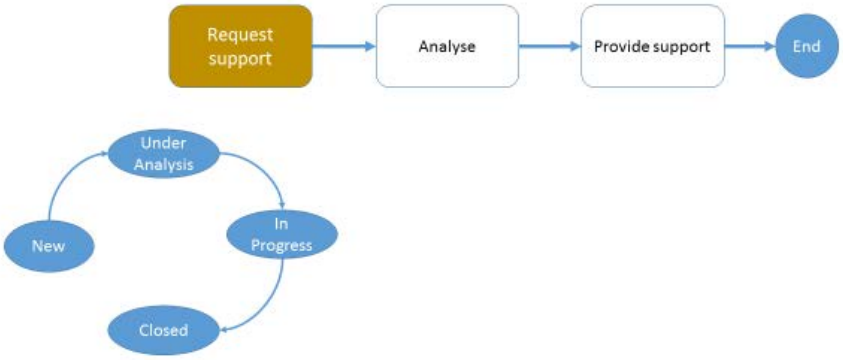

Figure 19: Support Management Process

4.2.3 Conformance & testing lifecycle management

Incident management process – Conformance & testing

The goal of this process is to register reports of non-expected behaviours of both Minder and Kerkovi platforms in production, and ultimately provide a fix if applicable. These platforms provide testing services to CEF, vendors etc. (see section 4.3).

The Change Manager person for Minder/Kerkovi distributes the tickets for analysis and resolution amongst the e-SENS Conformance Testing team, which is responsible for the development of said platforms. The exchanges with reporters, developers and other experts are documented in the ticket.

If the analysis of the incident identifies a complex change to be carried out, a new related Change Management ticket should be opened. Change size is based on effort estimation; a typical 'big' change should entail ca. 1 person-month, a 'small' one 0.25 person-month.

Just like with the Change Management process, the Release Management process is embedded in this workflow, in order to both document and expedite the full report-to-production cycle of less complex changes.

Figure 20 depicts the Incident Management workflow. On the lower left corner there is the complementing state-machine.

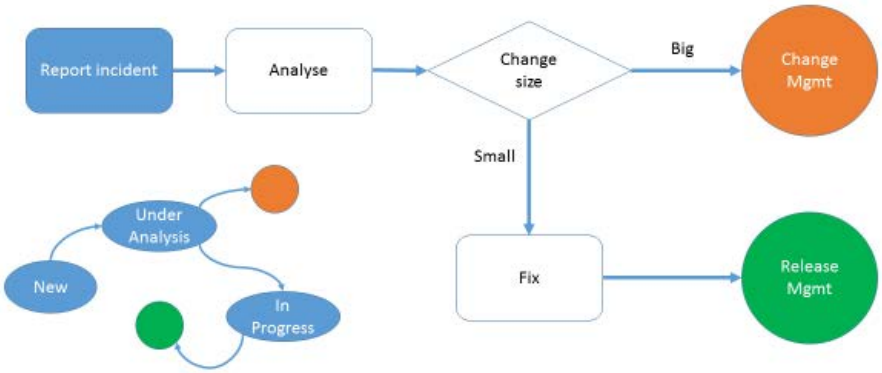

Figure 20: Incident Management Process

Change management process – Conformance & testing

The workflow is identical to EIRA's (Figure 17), the main difference in implementation is that the Change Manager for Minder/Kerkovi distributes the tickets amongst e-SENS Conformance Testing Team, which is the owner and operator of said platforms.

Support management process – Conformance & testing

The workflow is identical to EIRA's (Figure 19), however the nature of requests is expected to be different, namely the providing of Application Support. The Change Manager for Minder/Kerkovi distributes the tickets within e-SENS Conformance Testing Team, which is the owner and operator of said platforms.

4.2.4 Stats

Figures as of March 28th 2017

	EIRA LCM		**Conformance & testing LCM**	
	Total	Open	Total	Open
Change requests	19	2	3	3
Incident reports	-	-	12	12
Support requests	0	0	0	0
TOTAL	**16**	**2**	**15**	**15**

4.3 Conformance and IOP Testing

e-SENS Conformance Testing is the process of verifying that a SBB conforms with the requirements of the ABB Specifications it implements. e-SENS Interoperability Testing verifies the ability of two or more SBBs, which claim conformance to the same ABB specification, to work together properly. This section

describes the set of software architecture, platform, tools, supplementary testing assets and methodologies to facilitate and standardize the testing activities.

4.3.1 Testing Strategy

The following testing types are relevant in the scope of the e-SENS project: Conformance Testing, Interoperability Testing and End-to-End testing. Other types of testing, like performance testing, usability testing etc., are not in the scope of the testing activities in the e-SENS project.

Conformance Testing

Testing conducted to verify that an implementation conforms to a formal specification (typically one defined by a standards organization).

Interoperability Testing

Testing to verify that two or more software products are capable of interacting with each other, perhaps via a communications or messaging protocol, or by exchanging data through some other means. Note that conformance to specifications does not guarantee that two systems to be interoperable. However, it is beneficial to perform conformance testing to pave the way for interoperability testing.

End-to-End Testing

End-to-end testing is a methodology used to test whether an integrated system is performing as designed from start to finish with respect to the desired business level use cases. The technical level of integration, communication protocols, configurations and other low-level details are not so relevant, yet affected by this kind of test. Depending on the definition on the business level use case, end-to-end testing scenarios might also be domain agnostic. In e-SENS, the end-to-end testing is performed as part of the WP5 activities, and therefore not covered in details in this report.

The following criteria are used to identify the items to be subject to conformance/interoperability testing:

- When a software product (aka. System Under Test, SUT) is used as an SBB, Pilot Domain Experts & Solution Providers (in the role of Test Developer) must provide a software developer who knows the provided SW and develop/reuse an adaptor for Minder. After developing/reusing the Minder adaptor for that SUT, both conformance testing against an ABB and interoperability testing with other SBBs for the same ABB can be done automatically using Minder.
- When a pilot adapts an ABB where only the artifacts are significant (i.e. *SBDH, ASiC, etc.*) and the software is out of scope, then the conformance and interoperability tests can be performed by providing the artifacts as *test assets to Minder* and performing content validation.

It is important to note that *the systems to be tested* are expected to be stable and have robust releases. The releases are taken as versions and each test cycle is traced according to these releases.

As mentioned in section 2.2, software development activities like unit, functional, integration, system, performance and load testing are out of scope of the conformance and interoperability testing. Throughout the whole conformance and interoperability testing, the basic assumption is that the SUT has already completed the software development testing activities and that a stable release is available. Therefore, the versions like *beta, snapshot, alpha, pre-release and any other statement that implies a non-release version is under the responsibility of the vendor*. The vendors are welcome to

align their development calendars with the conformance testing plan but the quality assurance and conformance and interoperability testing team will reject any responsibility on the effects of the delays in the conformance tests cycles on the development-release calendar of the vendor.

The testing strategy applied to each building block is described in Annex III.

The testing procedure defines the steps required to perform conformance and IOP testing, as well as the operational roles and responsibilities. It is described in Annex IV.

4.3.2 Minder TestBed

e-SENS Conformance and Interoperability tests are performed on **Minder**, which is a generic online programmable flow control engine based on the Oasis Test Assertion Model. It provides a set of software architecture, platform, tools, supplementary testing assets and methodologies to facilitate and standardise the testing procedures in order to make the process reusable and sustainable.

Minder enables the interconnection of different systems under test (SUTs) in one node and performs complex communication operations on those interconnected systems. Programmers can create, group, edit and execute test cases implemented from test assertions and inspect and publish reports and logs about the results.

The main features of the Minder Testbed are listed below:

- Compliance with the OASIS Test Assertion Model;
- Allows Test Assertion grouping and coding in the form of Test Cases using MTDL (Minder Test Definition Language - based on SCALA). Multiple Test Cases for a Test Assertion are possible;
- Complex flow logic between Systems Under Tests is based on the Riveting mechanism. Rivets consist of Signals arriving from SUT's and one target SLOT (going to an SUT);
- Allows observation and manipulation of messages that flow between systems;
- Handles synchronous and asynchronous messaging;
- Allows multiple users with three Roles: Test Designer, Test Developer, and Test Observer;
- Contains built-in support for xml schema and schematron verification, and XPath;
- Supports library resolution using maven dependencies;
- Enables Test Result Logging and Reporting.

The general architecture of the test environment is given in Figure 21. For more details please refer to "e-SENS Minder Test Engine Server Installation and Administration Guide"[14], "e-SENS SBB-Minder"[15], "e-SENS Minder Test Designer Guide"[16], and "Minder Rest API"[17].

The Minder testbed was used in combination with the testing procedure described in Annex IV to perform conformance testing of various SBBs regarding the ABB specifications they implement. A detailed description of the conformance testing activities handled in the context of AS4 profile is provided in Annex VI: this success story illustrates the deployment of the testing tools and procedure in a real life case, and the ability of the testing infrastructure to support the conformance testing of several SBBs (open source as well as commercial products) with regards to the common technical specifications they implement.

[14] https://www.jol.nrw.de/bscw/bscw.cgi/d6623517/minder-setup_and_administration_guide-3.pdf

[15] http://wiki.ds.unipi.gr/display/ESENS/SBB+-+Minder+-+0.6.0

[16] https://www.jol.nrw.de/bscw/bscw.cgi/d6623506/minder-test_designer_guide_v0.7.pdf

[17] https://www.jol.nrw.de/bscw/bscw.cgi/d8216213/minder-rest-api_v1.3.pdf

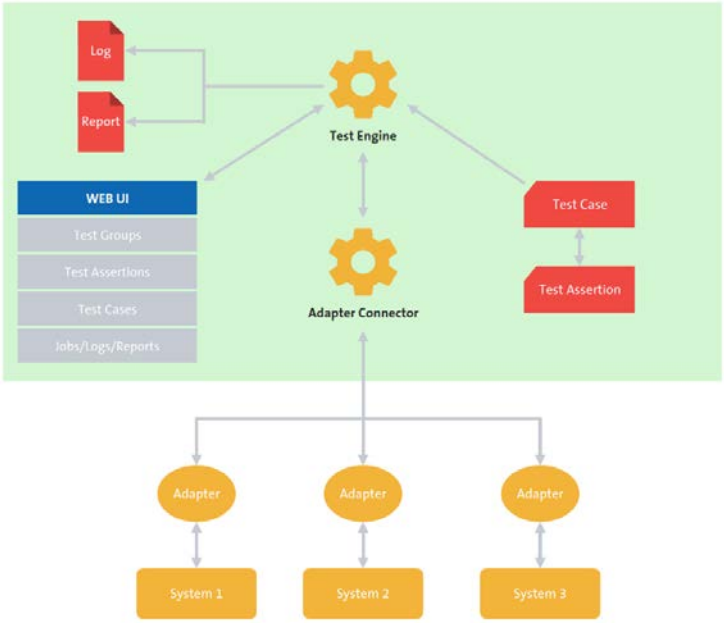

Figure 21 - Minder Applied Architecture

5 Alignment and cooperation with EC initiatives

5.1 STORK2.0 and eIDAS

STORK 2.0 ended in September 2015 and key artefacts were transferred to e-SENS for Life Cycle Management.

As the SAML protocols of an eIDAS node and the STORK2.0 PEPS are not compatible, the gap between the eIDAS „world" and the STORK 2.0 „world" needed to be bridged. Using the specific communication module of the eIDAS node 1.1, the e-SENS project developed an eIDAS/STORK plug-in for countries using STORK infrastructure.

The solution consists of a regular eIDAS node and a plug-in component, connected to the eIDAS node using the specific communication module. The plugin is able to convert in both ways the authentication requests and responses between the eIDAS format and the STORK 2.0 format. The plug-in also handles mappings of attributes between STORK 2.0 SAML and the eIDAS node SAML.

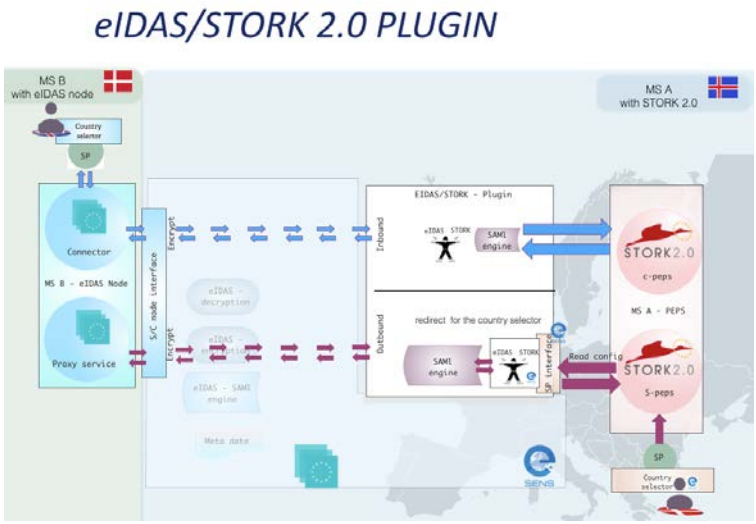

Figure 22: eIDAS/STORK2.0 Plugin Architecture

The eIDAS/STORK plugin comes in two versions. In one version the eIDAS node with the plugin acts as a middleware, connecting existing STORK 2.0 PEPS to the eIDAS network. In this version, service providers continue to be connected to the STORK 2.0 PEPS and all communication with Identity providers and attribute providers are done through the STORK 2.0 PEPS.

In the second version of the eIDAS/STORK plugin the STORK MS can turn off their PEPS as the STORK 2.0 service providers, STORK 2.0 Identity providers and attribute providers connect directly, using the STORK 2.0 protocol, to the eIDAS node with the eIDAS/STORK plugin. This ensures that the STORK 2.0 MS can continue to operate their STORK 2.0 services through their eIDAS node without the need to operate a STORK 2.0 PEPS.

This architecture ensures that, seen from other MS's, the STORK 2.0 MS in question it looks and feels as any other eIDAS node country, while their service providers can continue using their STORK 2.0 setup. This means that STORK2.0 countries, installing the eIDAS connector, can prolong the life span of the STORK 2.0 infrastructure and at the same time gives them the better possibilities to sustain the STORK2.0 services. The architecture offers MS a smooth migration path from STORK to eIDAS: installing the eIDAS/ STORK plugin makes it easier to switch from STORK2.0 PEPS to eIDAS node.

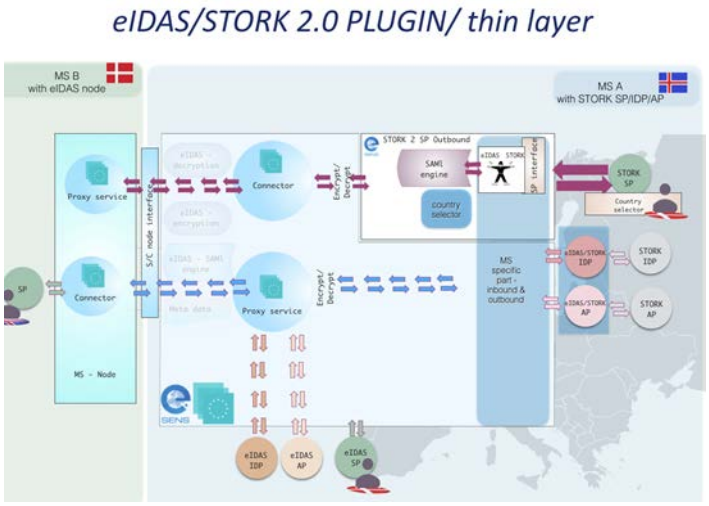

Figure 23: Thin Layer Architecture

5.2 ISA and ISA² Programme

5.2.1 European Interoperability Reference Architecture

The European Interoperability Reference Architecture (EIRA) is a four-view reference architecture for delivering digital public services (across borders and sectors).

It defines the required capabilities for promoting interoperability as a set of **Architecture Building Blocks (ABBs)**.

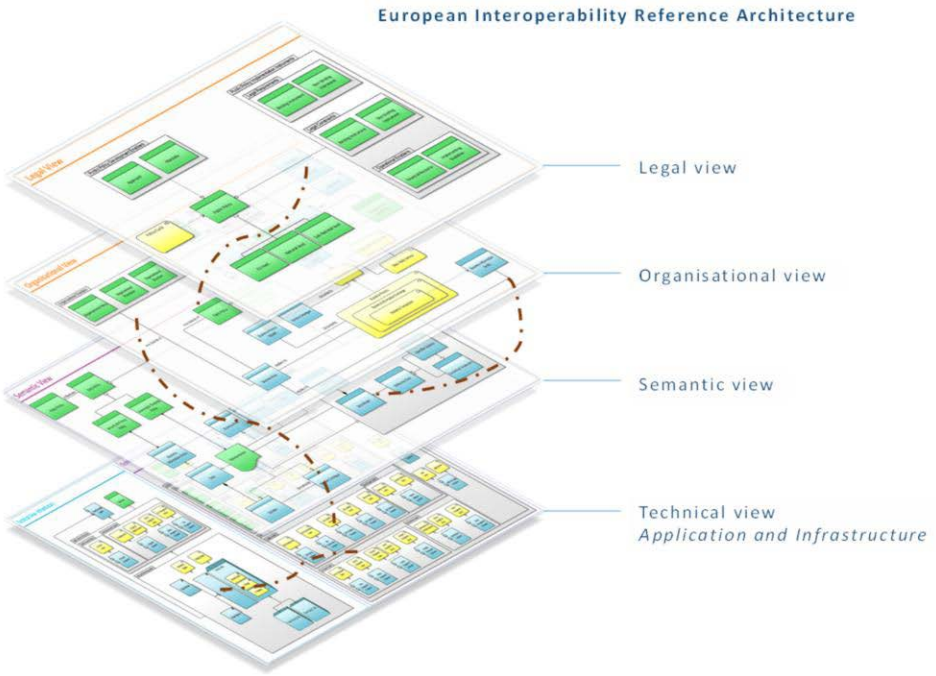

Figure 24: EIRA Views

A **Solution Architecture Template (SAT)** is a specification containing a sub-set of ABBs of the EIRA. It focuses on the most salient building blocks needed to build an interoperable solution addressing a particular interoperability need. A SAT consists of (Source: ISA EIRA – e-SENS WP6 pilot kick-off meeting on the 7.1.2015):

- A goal and description,
- A set of EIRA ABBs,
- A set of requirements & recommendations (linked to ABBs).

The ambition of e-SENS WP6 is to be fully compliant with the ISA EIRA. With the kick-off of ISA Action 2.1: European Interoperability Architecture, it is possible to align the work in WP6 and the ISA EIA project.

The following are issues, concerning the cooperation with ISA EIA project, which can influence on WP6 work:

- Alignment of definitions of artifacts e.g. ABB, SBB, SAT – this needs further analysis before adapting to the ISA EIRA vocabulary. In this Deliverable, the e-SENS definitions of SAT, ABB and SBBs are used.
- The current Cartography Tool (repository) for the description of artifacts is not publicly accessible, and the ISA EIA project is analysing licensing issues and other possibilities - for this Deliverable, a simple tool of WIKI technology has been chosen. The e-SENS EIRA will move its content into the ISA Cartography Tool, when the issues have been resolved in the ISA EIA project.

The ISA EIA project can be followed on JoinUp: https://joinup.ec.europa.eu/asset/eia/description

Compatible and Complementary Views

The ISA-EIRA main abstraction is the Interoperable European System (IES): an IES is an application component (i.e. a modular, deployable and replaceable part of a software system). The IES realizes Public Services by providing application services, which are used to realize the Business Capabilities required by the Public Service. The IES is supported by the Digital Service Infrastructure (DSI).

The ISA-EIRA identifies a set of components that any interoperable European system should/could contain: it targets software systems that directly realize public services. The scope of e-SENS is not to provide actual solutions, but building blocks that can be assembled to design IES.

An e-SENS Building Block, although very technical in nature, is modelled from different viewpoints (as defined in ISO/IEC 42010) according to the concepts defined in the Metamodel. From that perspective, there is a **strong alignment** between e-SENS and ISA-EIRA. However, the goals of the e-SENS Architecture and of the ISA-EIRA are different (although they complement each other): while ISA-EIRA concentrates on how the building blocks are used, e-SENS targets the architecture specifications of the building blocks. The views on the building blocks are therefore different: ISA-EIRA considers the **external interface** (provided services) of the building blocks, while e-SENS considers the **internal specifications** of the building blocks. These two complementary views on the same object (building block) can be integrated, so that it is easily possible to switch from one view to another.

The following view is an excerpt of the model representing the most important elements of the ISA-EIRA, as well as their relations (version 0.9.0_beta)

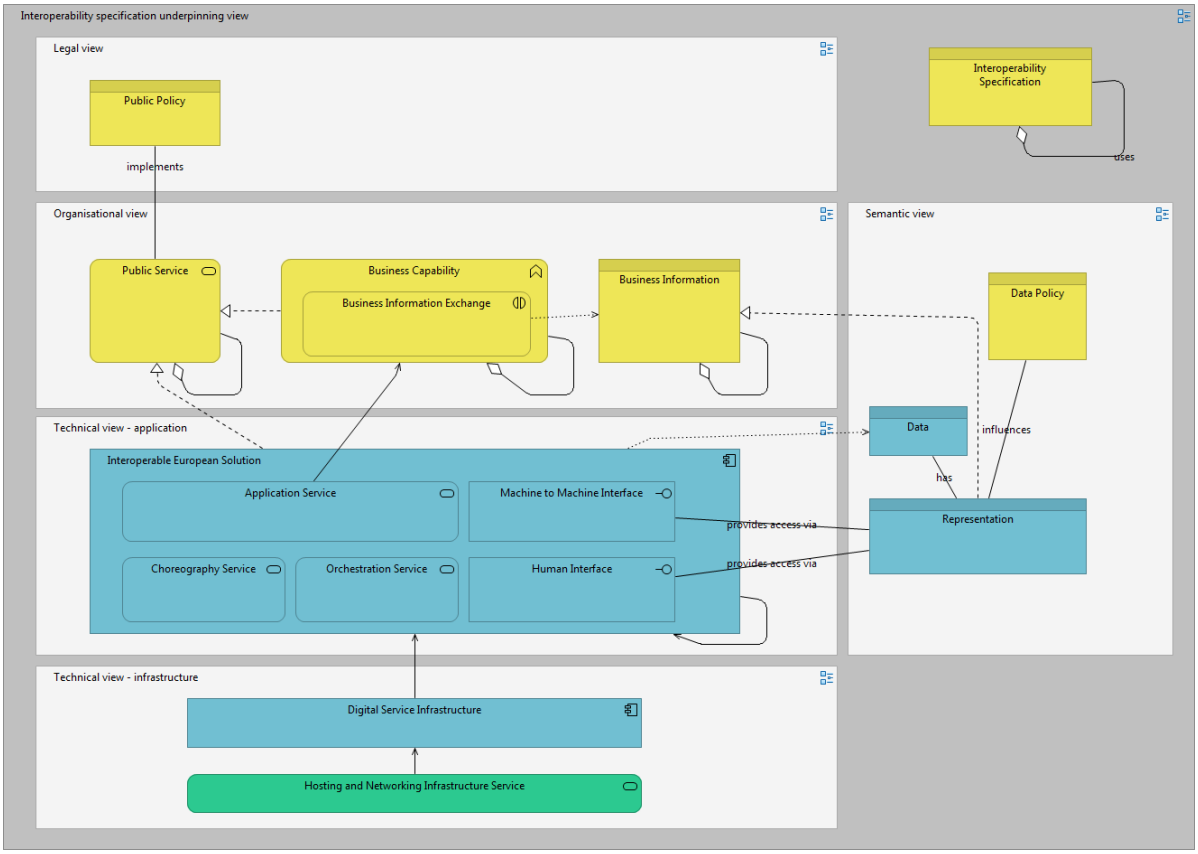

Figure 25: ISA-EIRA Main Abstractions

Conceptual alignment

A conceptual alignment has been realised according to the Metamodel integration approach proposed by Zivkovic, and the resulting concept mapping can be found below:

From: e-SENS Construct	e-SENS ArchiMate Type	To: EIRA Construct	EIRA ArchiMate Type	Mapping
eService	Business Service	Public Service	Business Service	Equivalence
Capability	Business Function	Business Capability	Business Function	Equivalence
Domain Information	Business Object	Business Information Entity	Business Object	Equivalence
Generic Requirement	Requirement			Extension
Feature	Application Function			Extension
Technical Specification	Constraint	Technical Specification	Business Object	Association

From: e-SENS Construct	e-SENS ArchiMate Type	To: EIRA Construct	EIRA ArchiMate Type	Mapping
Component	Application Component	IES	Application Component	Equivalence
Domain Data	Data Object	Data	Data Object	Equivalence

Table 12: Mapping e-SENS to EIRA

The mapping is graphically represented below:

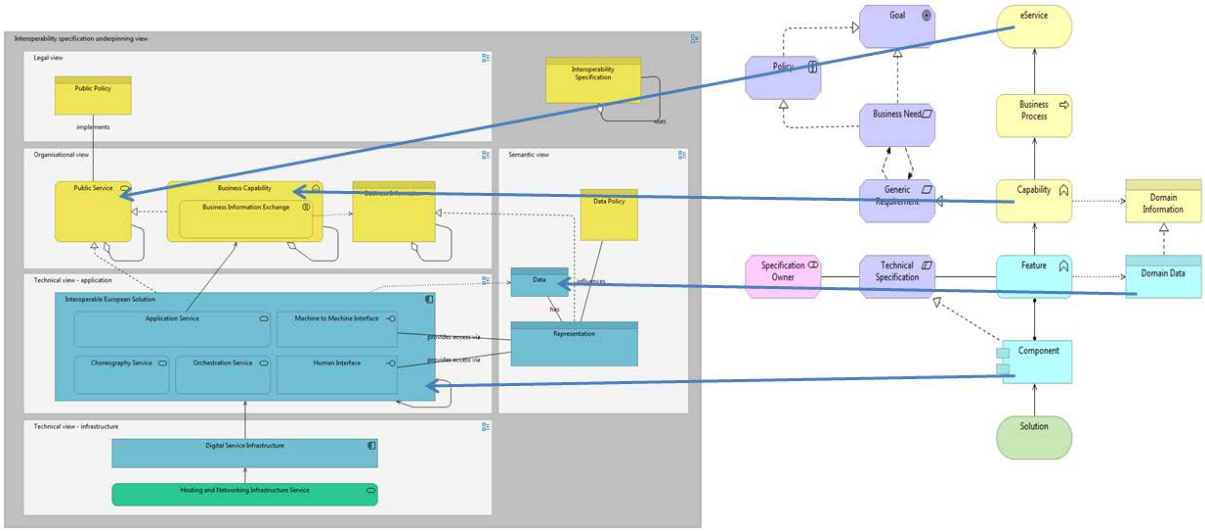

Figure 26: Mapping e-SENS to EIRA

The integrated model clearly shows that the e-SENS Metamodel complements the ISA EIRA with additional information concerned with the design aspects of the component: the requirements, the features and the associated specifications.

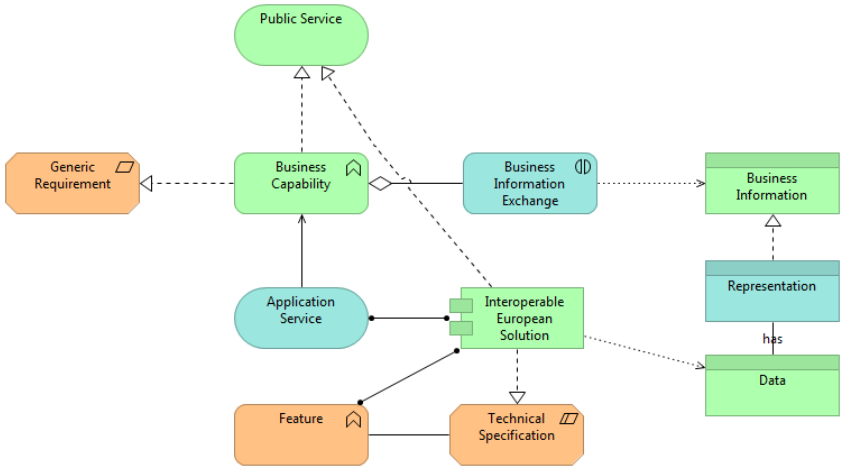

Figure 27: Mapping e-SENS to EIRA

5.2.2 e-SENS EIRA as ISA EIRA Pilot

From 7.1.2015 e-SENS WP6 has piloted the ISA EIRA with the following objectives:

Demonstrate that the usage of the EIRA and/or Cartography Tool provides value

- The benefit(s) of the use case is documented and understood;
- The outcome is in line with the expected benefit(s) of the use case;
- The pilot participant's perception of the EIRA's and/or Cartography Tool's value during the pilot.
- The pilot participant's perception of the EIRA's and/or Cartography Tool's value beyond the pilot.

Test EIRA and/or Cartography Tool use cases

- The use case documentation (including its expected result) is available and, if needed, updated with the gained insight from the pilot;
- A pilot participant was able to execute the different use case steps:
    - Each use case step is documented and understood;
    - Sufficient resources, tools and support were provided to apply the use case;
    - Each use case step was performed;
- The outcome is in line with the expected use case result.
- All feedback with regard to the usability, enhancement or non-existence of the applied uses case, the EIRA and the CarTool has been captured and, if applicable, managed as change requests.

Further contribute to the enhancement of the EIRA and Cartography Tool based on the pilot experiences

- The importance of the feedback on the EIRA and CarTool is understood;
- All desired changes or features to the EIRA and CarTool are captured and managed as change requests;
- All feedback is processed and, if applicable, all necessary change requests are initiated and managed

Current outcome has been:

- Documented e-SENS eDelivery in the CarTool
- Documented e-SENS e-Document in the CarTool
- Documented e-SENS e-Invoicing in the CarTool
- Documented e-SENS eSignature in the CarTool
- Documented e-SENS eID in the CarTool
- Good understanding of the meta data associated with the ISA EIRA Architecture Building Blocks
- Input to further work on incorporating ISA EIRA meta data attributes into e-SENS EIRA
- Feedback to ISA EIA project on findings in using the CarTool and its content
- Alignment of e-SENS EIRA Metamodel with the ISA EIRA

5.2.3 ISA – Testing

ISA Interoperability Test Bed action selected Minder as the first TestBed to be piloted for GITB compliance and assessed the GITB service compliance of Minder. The e-SENS Conformance Testing Team developed GITB service compliant services, which are not coded directly in Minder code, instead, opened as services through an intermediary adaptor called Minder GITB Bridge. This adaptor includes a "Content Validation Service" which exposes the schema/schematron abilities of Minder, a "Messaging Service" which provides network application layer service interfaces and a "TestBed Service" which is supported by Minder Bridge as SOAP services. Minder GITB Compliance study has been recently finalized and put on Join-Up and should be validated by ISA.

5.3 CEF

An indepth description of CEF can be found at: http://ec.europa.eu/digital-agenda/en/connecting-europe-facility.

A more specific description in the context of e-SENS WP6 cooperation i.e. collaboration community in the area of reusable building blocks provided by the Connecting Europe Facility (CEF), can be found at https://joinup.ec.europa.eu/community/cef/home .

From the second half of 2014, WP6 has participated in a series of meetings organized by CEF in order to find a common ground for cooperation. WP6 has, together with other external stakeholders, presented and discussed eDelivery, eSignature and eID with CEF. This has resulted in a close cooperation with CEF Architecture Management with biweekly net meetings.

5.3.1 Reference Architecture Alignment

The first task in the cooperation has started with a gap analysis on Building Blocks between CEF Architecture Management and e-SENS WP6. This gap analysis is the foundation for future prioritization and direction on work on the Building Blocks. Closing the gaps might induce either changes in the e-SENS Repository (to align with CEF), or a change on the CEF plans. The changes in e-SENS are managed through the Change Management Process, and the EIRA Release Management Process.

The continuous gap analysis is logged on a collaborative environment hosted by the EC.

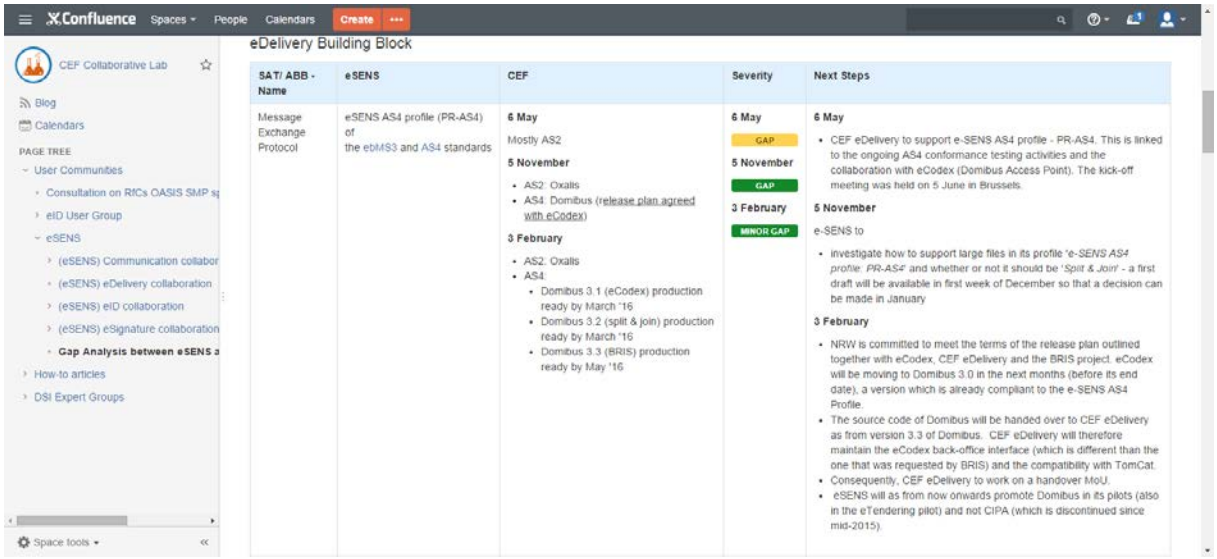

Figure 28: CEF Gap Analysis (illustration)

The continuous alignment between e-SENS WP6 and CEF Architectures has led to a smooth handover process, as described in Deliverable D6.5.

In parallel, ABB used within the eHealth pilot have been submitted for handover to the eHealth DSI through a separate Change Proposal Process[18]. These ABB includes Capability and Location Lookup, Non Repudiation, and the eID SAT. The ABBs have been profiled and combined together in Change Proposals[19] aiming at amending and completing the eHealth DSI specifications. Architectural descriptions and community discussions are available in the OpenNCP wiki[20].

[18] defined in https://ec.europa.eu/cefdigital/wiki/pages/viewpage.action?pageId=35210519

[19] https://ec.europa.eu/cefdigital/wiki/pages/viewpage.action?pageId=35210522

[20] https://ec.europa.eu/cefdigital/wiki/display/EHNCP

5.3.2 CEF Architecture Management

The second task has been to make a gap analysis on the activities carried by CEF Architecture management and e-SENS WP6. CEF has a list of Activities, classified into Disciplines, which they need to prioritize:

DISCIPLINE	ACTIVITY
PROMOTE Alignment	Develop and promote the adoption of common DSI principles (aligned with the EIF)
	Develop and maintain a common vocabulary for all DSIs to use
	Guide DSIs in the alignment of policy objectives, legal constraints and technology choices
	Together with architects of Member States, create and evolve an overall CEF target architecture based on the CEF building blocks (taking into account the eSENS architecture based on the EIRA project of ISA)
STIMULATE Synergies	Continuously create DSI blueprints in a common modelling language such as Archimate 2.1
	Develop and maintain a publicly available 'CEF reuse registry'
	Continuously develop best practices based on the experience of the DSIs and Member States
	Help identify further opportunities for the building blocks to spread across the EU
DRIVE Interoperability through Standardisation	Maintain a DSI standards database
	Maintain a catalogue of CEF building blocks and put standards and specifications at its core
	Continuously promote collaboration between DSIs, Standards developing organizations (SDOs) and the 'European Multi Stakeholder Platform on ICT Standardisation'
	Help resolve issues where interoperability/ standards conflicts arise amongst DSIs
	Monitor the market's adoption of standards used by the DSIs and support their promotion

Figure 29: CEF Disciplines and Activities

5.3.3 CEF eDelivery Conformance Testing

In December 2015, e-SENS made the first call for e-SENS AS4 conformance testing; and during January 2016, e-SENS AS4 profile conformance tests were performed for the applicant vendors' implementations "Holodeck B2B AS4 GW", "Flame Message Server" and "Domibus" successfully in Minder. After a successful Conformance Testing event, CEF programme selected Minder as the TestBed for eDelivery DSI and WP6.A Conformance and Interoperability Task Force received an assessment that includes 8 change requests on Minder. WP6.A Conformance and Interoperability Task Force planned to apply and release these changes in two versions. The first release has been issued at the end of the March 2016 by the e-SENS Conformance Testing Team.

The CEF is now managing the e-SENS AS4 Interoperability testing, using the Minder-Kerkovi AS4 testing architecture. The CEF eDelivery team created e-SENS SMP profile Conformance Test Assertions and, in parallel, wrote the related test case scripts in Minder with the guidance of the e-SENS Conformance Testing Team. After finalizing these studies, the CEF eDelivery team called for public and/or private vendor's products. In 2016, CEF announced that Phoss SMP was the first and only implementation that applied and passed the CEF eDelivery OASIS SMP Conformance Tests.

5.4 TOOP Project

The TOOP project is part of the EU eGovernment Action Plan 2016-2020 and will contribute towards increasing the efficiency of the Digital Single Market. The project will ensure that information is supplied to public administrations only once regardless of the company's country of origin therefore

eliminating unnecessary burdens for European businesses who are asked to repeatedly present the same data and documents. According to the “Once-Only” principle, public bodies should take action to share data with each other, respecting privacy and data protection rules, both nationally (across sectors) and across borders. This calls for a generic and scalable solution to interconnect different systems.

Building bridges between data consumer applications and data sources such as Business Registries, without interfering with existing national infrastructures requires an innovative federated architecture on a cross-border, collaborative, panEuropean scale. The development of such architecture - to connect registries and eGovernment architectures in different countries - is the main goal of the TOOP project. TOOP will consider the existing EU frameworks (EIRA, EIF) and the reuse of the common IT components (Building Blocks) developed by the e-SENS project and operated as Digital Services Infrastructures of the Connecting Europe Facility.

Besides the reuse of e-SENS Building Blocks, the project also considers adopting the e-SENS Metamodel, and the ArchiMate modelling approach followed in the e-SENS project.

Conclusion

This deliverable has provided a structured overview of SATs, Specification Profiles, ABBs and SBBs provided by e-SENS WP6 for WP5 Pilots. This was done by creating a (EIRA) repository that supports the availability of the different Building Blocks and Artefacts.

This 4th version of the EIRA deliverable has met its defined objectives of:

- Use experiences from the pilots to finalize a coherent ICT architecture to be ready for Transition into full scale production: feedback from the pilots have been integrated in the description of the various Building Blocks;
- Support e-SENS Pilots in Implementation, Test and Deployment: a comprehensive Life Cycle Management process has been rolled out and experienced;
- Support other LSP Pilots e.g. STORK 2.0 in Deployment (Life Cycle Management): the plugin architecture for STORK-eIDAS Integration is described as part of the EIRA.

Annex I – Metamodel Definition and ArchiMate Mapping

The e-SENS Metamodel is a specialization of ArchiMate as it defines additional concepts atop the standardized language. It however fully conforms to ArchiMate specifications, as only the allowed extension mechanisms are used.

The table below defines each of the e-SENS Metamodel construct, and identifies the mapping to the ArchiMate type.

Name of Construct	Definition	ArchiMate Type
Conceptual Architecture		
Capability	The ability and capacity to achieve a goal in the context of a specific e-SENS cross-border domain [FP7-CaaS]. The Capability addresses what is being achieved (the purpose) by the Building Block, rather than how it is achieved.	Business Function[21]
Domain Information	Piece of business data or a group of pieces of business data with a unique business semantics definition in a specific business context [ISO15000-5, UN/CEFACT CCTS]. Domain Information is used by a Building Block to meet its objectives. Domain Information may have association, specialization, aggregation, or composition relationships with other Domain Information. They are always realized by data objects, as Building Blocks are fully automated in e-SENS.	Business Object
Generic Requirement	A statement of generic need that must be realized by an e-SENS Building Block. The Generic Requirements are architecture requirements. They are generic in the sense they are not specific to any domain of application.	Requirement
Logical Architecture		
Feature	A distinguishing characteristic of a software item (e.g., performance, portability, or functionality) [IEEE-829]	Application Function
Technical Specification	An established norm or requirement in regard to technical systems. It is usually a formal document that establishes uniform engineering or technical criteria, methods, processes and practices.	Constraint

[21] ArchiMate 3.0 (released in June 2016) supports the concept of Capability, in a strategic perspective. The e-SENS project used ArchiMate 2.1, without the concept of Capability.

Name of Construct	Definition	ArchiMate Type
	A Technical Specification is a generalization of the Technical Standards, as e-SENS might adopt Technical Specifications that are not standardized yet.	
Specification Owner	The owner of the Technical Specification. The Specification Owner is a generalization of the Standards Developing Organization (SDO) and Standards Setting Organization (SSO).	Stakeholder
Component	A logical module that encapsulates a set of related Features. A Component realizes the specifications associated to the Features it does encapsulate.	Application Component
Domain Data	A passive element suitable for automated processing. It is the realisation of the domain information through standard data object. It is part of the logical data model.	Data Object
Physical Architecture		
Solution	The physical representation of the solution implementation. It is the physical representation of the application component. It might be an Open Source Implementation, a Commercial Product, a Reference Implementation, …	Infrastructure Service

Table 13: Metamodel Concepts

The core Metamodel is extended with additional concepts required to support additional perspectives on the e-SENS Architecture:

- The Business Needs perspective, capturing the motivational aspects of the e-SENS Building Blocks, i.e. why the Capabilities are designed;
- The Service perspective, capturing the usage aspects of the e-SENS Building Blocks, i.e. how the Capabilities are assembled to serve;

The following constructs are used in the Metamodel to cover these aspects:

Name of Construct	Definition	ArchiMate Type
Motivation Architecture		
Goal	The high-level objectives an organization can achieve by adopting a Building Block. Goals are usually expressed in the following terms: Interoperability, Security, Privacy, Scalability and Performance, Legal Assurance and Compliance. [CEF]	Goal
Policy	Whole of actions under a policy domain taken by a public authority to bring about social change in the	Principle

Name of Construct	Definition	ArchiMate Type
	medium and long term. It is based on certain values and objectives and is implemented using a variety of methods. It applies on the territory within which the authority is authorised to act [Eurovoc]	
Business Need	The detailed business needs, linked to the goals, which can be satisfied through the adoption of Building Blocks. [CEF]	Requirement
Usage Architecture		
eService	A service delivered via the internet, or an electronic network, where supply is essentially automated, or involves only minimal human intervention, and impossible to ensure in the absence of information technology. [EC Implementing Regulation 282/2011]	Business Service
Business Process	A business process is defined as a behavior element that groups behavior based on an ordering of activities. [ArchiMate] The Business Process in e-SENS details how a eService is realized in terms of required BB Capabilities.	Business Process

Table 14: Extension Concepts

Annex II.a – Asset Description (SAT)

Each SAT is described according the following template:

Name of SAT: SAT-*ProductName-version (SAT-eID-1.0.0)*

Objective: *A description of the purpose of the SAT, i.e. what cross-border service this SAT is a template for*

- *Target group: ICT Architects*
- *Must be written in a technology neutral way*
- *Must be short and straight to the point*
- *Must contain the e-SENS specific constraints to the definition*

Generic Requirements: a table listing the generic requirements associated with this SAT

Requirement ID	Requirement description	Compulsory	Source
R-*short name of SAT-Type1**	*Clear and to the point description of the requirement*	*Yes – requirement is applicable to all domains of use* *No – requirement is domain specific and is only applicable to some domains of use*	*Should reference the source of the requirement e.g. from WP5*
R-*short name of SAT-Type2**			

Table 15: SAT Requirements

**ID*

- *R=Requirement*
- *Short name of SAT is 3 letters of the name(s)*
- *Type*
  - *P=Political – requirement coming from political issues e.g. interoperability legacy in domains*
  - *L=Legal – requirement coming from legal interoperability issues*
  - *B=Business – requirement coming from business value proposition perspective*
  - *S=Semantics – requirement to the semantics parts of the foundation architecture (can be derived from the P, L, B requirements)*
  - *T=Technical – requirement to the technical parts of the foundation architecture (can be derived from the P, L, B requirements)*

The target group is non-technical domain experts and ICT architects.

Use cases and Scenarios: The objective is to give domain experts and ICT Architects an understanding of applicability of the architecture of the SAT, through generic and/or domain specific use cases and scenarios.

Use Case	*Objective of the use case*
Description	*Description of the use case*
Actors	*Actors involved*

Goals	*The goal of the use case i.e. business purpose*
Assumptions	*Assumption made in this use case e.g. domain specific*
Artifacts	*Description of artifacts that are being used in the use case*

Table 16: SAT Use case

Architecture patterns and variability: A solution architecture template might enforce a specific architecture pattern (such as 4-corner model). A solution architecture template might support some variability (such as direct addressing of message or addressing through SMP).

Pattern	Variation	ABB Configuration
Name of the pattern solution	*Potential variations*	*What ABB are used in this specific configuration of the solution architecture*

Table 17: SAT pattern and variability

Orchestration and topology of ABBs

- Orchestration = How the different ABB (services) are assembled (orchestrated) to provide a solution architecture. Orchestration is not always required.
- Topology = where each ABB sits in the architecture of the solution

Contributors

Name	Organisation	Country
Name of Contributor as stated in Timelog	*Name of organisation as stated in the Technical Annex and Timelog*	*Name of Country*

Table 18: SAT Contributors

History

Version	Date	Changes made	Modified by
9.9.9	*dd.mm.yyyy*	*Description of changes*	*Name of author*

Table 19: SAT History

Annex II.b – Asset Description (ABB)

Each ABB should have the following sections.

Name: ABB-*name of AB-version (ABB-LocationLookup-1.1.0)*

- Must be a name that covers the functionality of the ABB
- Must not conflict with any other HBB or ABB names

Interoperability level

One of the following figures must be included to show the placement of the ABB in the EIF interoperability levels:

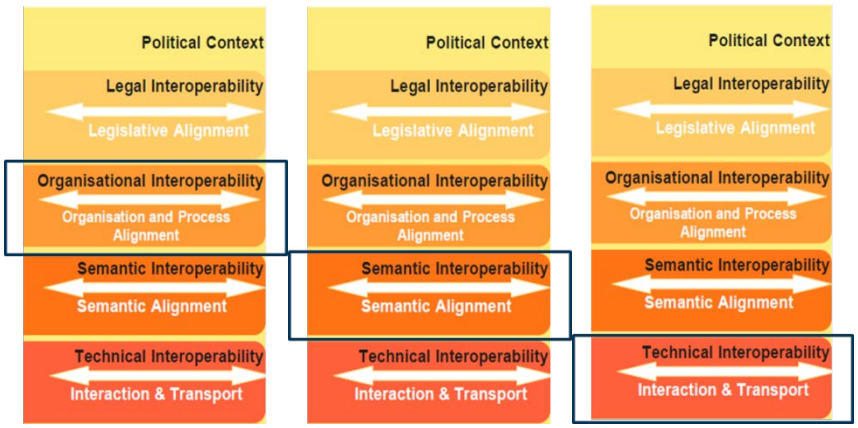

Figure 30: EIF Levels

Objective

A conceptual description of the purpose (WHAT the ABB is doing) and scope of the ABB. The target group is ICT architects.

Generic Requirements

Requirement ID	Requirement description	Source
R-*short name of ABB-Type1**	*Clear and to the point description of the requirement*	*Should reference the source of the requirement e.g. from WP5 or SAT*
R-*short name of ABB-Type2**		

Table 20: ABB Requirements

**ID*

- *R=Requirement*
- *Short name of ABB is 3 letters of the name(s) e.g. "Service Location" becomes "SerLoc"*
- *Type*
  - *P=Political – requirement coming <u>from</u> political issues e.g. interoperability legacy in domains*
  - *L=Legal – requirement coming <u>from</u> legal interoperability issues*
  - *B=Business – requirement coming <u>from</u> business value proposition perspective*
  - *S=Semantics – requirement <u>to</u> the semantics parts of the foundation architecture (can be derived from the P, L, B requirements)*

- *T=Technical – requirement to the technical parts of the foundation architecture (can be derived from the P, L, B requirements)*

Provided Services

For each Service that the ABB provides, what are the domain objects manipulated and the outcome (the net effect) in terms of domain objects

Provided Service	Purpose	Outcome
Authentication Request Creation	*Create an authentication request from identity attributes*	*Authentication Request is created*

Table 21: ABB Provided Services

Related ABBs

- List of ABBs (if any) that this ABB depends upon

ABB Capability Realization

- Description of the possible and adopted specifications and profiles to this ABB

When different solutions are adopted, explain when to use which. When a specific solution is chosen, justify the choice (potential link to decision log).

Specification	Reference	Sustainability assessment	
Name and version	*Link to specification*	*Link to maturity status from WP3*	
e-SENS Profile		**Choice criteria**	**Status**
Name and version	*Link to Specification Profile*	*When to choose this Profile*	**Work in progress** – The artifact is not yet ready to be used, but is publicized because it gives some information on the direction for the community **Phase in** – The artifact is replacing another (phase out) artifact **In use** – The artifact is the official e-SENS artifact to be used **Phase out** – The artifact is in use, but is being replaced by a new (phase in) artifact **Abandoned** – The artifact is not used anymore
Name and version	*Link to Specification Profile*	--	--

Table 22: ABB Specifications

Contributors

Name	Organisation	Country
Name of Contributor as stated in Timelog	*Name of organisation as stated in the Technical Annex and Timelog*	*Name of Country*

Table 23: ABB Contributors

History

Version	Date	Changes made	Modified by
9.9.9	*dd.mm.yyyy*	*Description of changes*	*Name of author*

Table 24: ABB History

Annex II.c – Asset Description (PR)

Each Specification Profile should have the following sections.

Name: PR – *SpecificationProfileName-version (PR-BDXL-1.0.0)*

Specification	Reference
Name and version	*Link to specification*

Table 25: PR Specifications

Profile choice criteria

When to choose this Profile

Ownership

Description of ownership (IP) and licence of both the specification and the profile.

Implementation Guideline

Either a link to an external implementation guideline or the implementation guideline description

Test assertions

Link to test assertions

SBB

SBB	Reference
Name and version	*Link to SBB*
Name and version	*Link to SBB*

Table 26: PR Implementations

Contributors

Name	Organisation	Country
Name of Contributor as stated in Timelog	*Name of organisation as stated in the Technical Annex and Timelog*	*Name of Country*

Table 27: IG Contributors

History

Version	Date	Changes made	Modified by
9.9.9	*dd.mm.yyyy*	*Description of changes*	*Name of author*

Table 28: IG History

Annex II.d – Asset Description (SBB)

Each SBB should have the following sections.

Name: SBB-*name of SB-version*

Must be a name of the product/SW

Must not conflict with any other SBB names

Reference

Reference to Product/SW

Owner and License

Ownership (IP) and License of Product/SW

Profiles implemented

Implementation Guideline	Reference	Release date
Name and version	*Link to implementation guideline*	
Name and version	*Link to implementation guideline*	
Name and version	*Link to implementation guideline*	

Table 29: IG Specifications

Conformance

Implementation Guideline	Test Wrapper	Test Cases	Conformance Status
Name and version	*Link to test wrapper*	*Link to test cases*	*Status of conformance testing*
Name and version	*Link to test wrapper*	*Link to test cases*	*Status of conformance testing*

Table 30: IG Conformance Testing

Contributors

Name	Organisation	Country
Name of Contributor as stated in Timelog	*Name of organisation as stated in the Technical Annex and Timelog*	*Name of Country*

Table 31: SBB Contributors

History

Version	Date	Changes made	Modified by
9.9.9	*dd.mm.yyyy*	*Description of changes*	*Name of author*

Table 32: SBB History

Annex III – Testing Strategies

eID Testing Strategy

e-SENS eID SAT has three BBs named “Authentication Exchange Protocol”, “Authentication Exchange Forward” and “Quality Authentication Assurance”. The specifications of these BBs have been inherited from STORK2.0 specification. (Note that STORK1.0 is not in the scope of e-SENS eID BB.) It’s because of this one to one relation between the solution and its specification that no conformance testing on STORK2.0 has been considered. On the other hand, the eIDAS Node specifications are not specific to a certain product and multiple implementation candidates are likely to occur. Consequently, all the three tests are required for the eIDAS Node specifications.

As a prerequisite to conformance testing against the candidate eIDAS Node implementations, a set of test assertions[22] must be derived from eIDAS Node specifications. Generally, BB experts generate these assertions. Subsequently, conformance tests must be applied on the candidate eIDAS Node implementations by using the test assertions.

eIDAS Node Interoperability testing aims to verify compatibility between different eIDAS Nodes. In order to accomplish this, testing scenarios must be generated in collaboration with BB experts and implementation vendors.

Member states, which use the e-SENS eIDAS Node implementations or the STORK 2.0 system, may apply end-to-end testing for business level scenarios to ensure all the integrated systems work together properly. In order to perform an end-to-end testing in the eID pilot, the national systems must be connected to each other via the eIDAS or STORK2.0 Nodes.

Adaptor Approach

A study has been going on for developing an adapter to make STORK2.0 and eIDAS Node implementations interoperable. This interoperability aims to ensure a STORK2.0 system deployed with an adapter behaves like an eIDAS Node (See Figure 35). Therefore, for a “STORK2.0 with adapter” solution, conformance testing against eIDAS Node specifications and interoperability testing with other eIDAS Node can be applied. Similarly, end-to-end testing may be applied with a “STORK2.0 with adapter” solution that connects to the eID interoperability architecture.

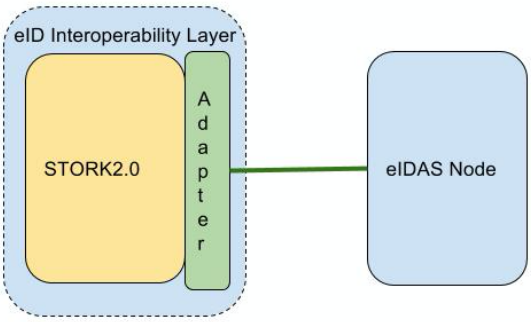

Figure 31- The testing approach for "STORK2.0 with Adapter" solution

22 e-SENS test assertion template is compatible with OASIS Test Assertions Guidelines
http://docs.oasis-open.org/tag/model/v1.0/testassertionsmodel-1.0.html

e-SENS Attribute Provider SAT and their ABBs are inherited from STORK2.0 project. Therefore eID testing strategy also applies to Attribute Provider SAT.

eDelivery Testing Strategy

e-SENS eDelivery SAT defines BBs, namely "Message Exchange", "Addressing of End Entities", "Capability Lookup", "Service Location" and "Backend Integration", and their specifications for secure electronic delivery. For "Backend Integration" BB, neither conformance nor interoperability testing is considered since i) the specification "Connector" is inherited from the solution "Connector" itself and ii) the specification "REST SMP" defines simple functions of a RESTful web service. However, for all BBs including "Backend Integration BB", Member States may apply end-2-end testing for technic and business level scenarios to verify all integrated systems work together properly.

For the profile "e-SENS AS4" of BB "Message Exchange", CEF and e-SENS eDelivery teams, collaboratively, generated 48 Conformance Test Assertions from the profile and Minder team from TUBITAK scripted all test cases using Minder testbed. Minder testbed is developed by TUBITAK team and is selected by the CEF programme as the testbed for the eDelivery DSI. The success story of e-SENS AS4 Conformance Testing is given in Annex V in detail. e-SENS AS4 profile Conformance and Interoperability Testing are handled by using the Minder AS4 Conformance Bridge "Kerkovi"[23] which is also the starting point for a new AS4 implementation. AS4 software provider may apply e-SENS AS4 Conformance Testing event via eDelivery Service Desk[24] . Prior to applying Conformance Test, a Connectivity Test takes place for a newly installed AS4 Access Point to test if it can successfully communicate with the sample AS4 Access Point hosted by European Commision. The following products applied and completed the conformance testing activities successfully: "Holodeck B2B AS4 GW", "Flame Message Server", "IBM Advanced Communication Gateway", "EESSI AS4.NET", "Laurentius", "Mendelson" and "RSSBus". The conformance testing of the "ADES" and "Integration Cloud" products are still in progress.

The e-SENS AS4 Interoperability testing work is an ongoing event being driven by the CEF using the Minder-Kerkovi AS4 testing architecture. Since it was first held within the WP5.1 e-Procurement AS4 Interoperability testing, this new event can be considered as the second interoperability event. The first phase of the current interoperability event has started at March 2017 and is planned to end at the end of the same month. The testing scenarios are basic one way, two way tests as well as large file tests. The upcoming phases will be distributed to 2017 and will include additional ABBs such as SML and SMP gradually. The AS4 vendors that participate in the event are: Domibus (CEF), IBM B2B, Flame Messaging Server, Holodeck, AS4.NET (EESSI) and RSSBus.

CEF generated 26 e-SENS SMP Profile Conformance Test Assertions and Minder team guided the CEF team for scripting all test cases using Minder TestBed. In 16th of 2016, CEF announced that Phoss SMP was the first and only implementation that applied and passed the CEF eDelivery OASIS SMP Conformance Tests.

[23] https://mindertestbed.org:15000

[24] https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/eDelivery+Service+desk

e-SENS Non-Repudiation SAT defines BBs “Timestamping” and “Evidence Emitter” with their specifications. e-SENS traceability team are currently working on e-SENS Timestamping standards Conformance Test Assertions for timestamping service that is implemented according to RFC 3339. On the other hand, ETSI Plug Test results are accepted for trusted timestamping service that is based on RFC 3161 and ETSI standards[25]. “Evidence Emitter” BB has two specifications called “ETSI REM” and “ATNA”. For “ETSI REM” specification, first Conformance Testing Test Assertions will be generated, then test scripts will be written and run in Minder. Gazelle Results are accepted by e-SENS as conformity proof to “ATNA”. No interoperability testing activity is planned for this BB since it is not applicable. However, for all BBs of this SAT, Member States may apply end-2-end testing for technical and business level scenarios to verify all integrated systems work together properly.

e-Documents Testing Strategy

e-SENS e-Documents SAT defines BBs “Document Provisioning”, “Document Business Envelope” and “Document Container” with their specifications. “Document Container” BB specification is based on the ETSI TS 102 918 ESI ASIC Specification. “Document Container” BB should satisfy the specifications extended from ETSI TS 102 918 ESI ASIC Specification. Conformance testing test assertions have been generated. Test cases will be generated from the test assertions and test scripts will be written and run in Minder. “Document Provisioning” BB includes W3C XSL, XSLT, Open Annotation (OA) Data Model, Schematron specifications. No conformance and interoperability testing activity is planned for this BB since it is not applicable. However, for “Document Provisioning” BB, Member States could apply end-to-end testing for technic and business level scenarios to verify all integrated systems work together properly. “Document Business Envelope” BB specification is based on the SBDH Profile. The conformance testing approach for SBDH Profile includes two steps for SBDH conformance testing:

1. Upper Level Testing: An e-SENS SBDH pilot profile schema/schematron is verified against e-SENS SBDH profile schema/schematron. Instead using schema and schematrons, test assertions are created and the pilot profile can be verified against these clauses. Once the pilot profile’s compatibility is verified with e-SENS SBDH profile, lower level test will be applied. Upto now, WP6.A has created and finalized SBDH TA document.
2. Lower Level Testing: An SBDH document received from pilot will be verified against e-SENS SBDH pilot profile we have verified in the following step. This step includes the verification based on XSD/schematron validation. The XSD/schematrons that profiled by each pilot - and for each pilot profiling - a sample SBDH document should be provided. They are requested from the pilots and some sample xml and excel sheets are delivered. But, what is really expected is, xsd and/or schematron of "profile of e-SENS SBDH profile" for each pilot. These xsd/schematrons must include the value constraints for your domain.

[25] http://wiki.ds.unipi.gr/display/ESENS/SP++-+Timestamping+Standards+1.1

e-SENS Semantics SAT defines BBs “Semantic Mapping Service”, “Terminology Service” and “Domain Knowledge Management System” with their specifications. Conformance or interoperability testing activities are not planned for this BB since it is not applicable. However, for all BBs of this SAT, Member States may apply end-to-end testing for technic and business level scenarios to verify all integrated systems work together properly.

eSignature Testing Strategy

The eSignature Creation and Validation ABBs relies on the EU eSignature legislation (first the Signature Directive 1999/93/EC, the Format Decision 2011/130/EU and the Trust List Decision 2009/767/EC, 2010/425/EU; later replaced by the eIDAS Regulation (EU) 910/2014, the Format Decision (EU) 2015/1506, and the Trusted Lists Decision (EU) 2015/1506, respectively) as the legal backbone, the EU eSignature Standards Framework which is described by the ETSI “Rationalised Framework for Electronic Signature Standardisation” as the interoperability backbone, respectively[26]. Hence, if an SBB is already performed the ETSI Plugtests and succeeded it is accepted as they it is conformant to e-SENS specifications when proved by some means.

Note from e-SENS WP4:

Regulation 910/2014 of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market will repeal Directive 1999/93/EC, from beyond 1 july 2016, so it must be thought on the near future compliance with the requirements set in the mentioned Regulation

[26] http://wiki.ds.unipi.gr/display/ESENS/SP+-+e-Signature+Standards+for+Creation+and+Validation-+1.2

Annex IV – Conformance Testing Procedure

Operational Roles and Responsibilities

The roles and the responsibility of the entities that participate in the conformance and interoperability testing activities are listed below:

1. **Test Designer**: is responsible for creating test scenarios according to the test assertions, which are supposed to be obtained from WP6 or the providers of the inherited specification. After creating test scenarios, TS can also run the test cases. TS can communicate with Minder Server via a web interface.
2. **Test Developer:** is responsible in creating the bridge between the SUT and the testing environment. He knows all the communication interfaces of the SUT. A TD is responsible to implement the adapter interface provided by Minder. If the SUT uses a standard communication interface (i.e. AS4, Rest Calls. etc), the TD might also reuse an existing minder adapter from the Minder Repository.
3. **Pilot Domain Experts & Solution Providers:** are responsible to provide solutions to be deployed in the pilot domains. Therefore, they provide technical support for the implementation of the SUT-Minder adapter (or reuse of an existing one) as Test Developer. Preferably, they may also be in the role of Test Designer and create test scenarios.
4. **BB Experts**: are responsible to give support for the generation of the test assertions and give support for the preparation of the test cases generated from assertions. Circumstantially, BB Experts might also be in the role of Test Designer and create test scenarios.

Coverage of Testing Types

Conformance testing is the process of verifying that a product, system or artifact/complies with the requirements of a specification. On the other hand, Interoperability Testing verifies the ability of two or more products/systems as which implement a target specification, to work together. Conformance testing does not cover the interoperability of two systems and interoperability testing cannot be a substitute to conformance testing. However, studies show that applying conformance tests at first reduces the cost and increases the successes of interoperability testing.[27]Therefore, it is recommended to conduct the conformance test for an SBB prior to interoperability testing.

When there are multiple implementations that realize the relevant part of an ABB specification, , each implementation (e.g. eIDAS node) must be tested with all the candidate implementations that realize its role in the interoperability architecture. This might lead the testing environment to an exponentially growing size that is unmanageable. Therefore, it is recommended to devise ways to apply automated interoperability testing in order to succeed future sustainability.

[27] https://wiki.oasis-open.org/tab/TestingPolicy

Due to the general testing notion that, the modules working fine individually do not tend to work together correctly for the first time, end-to-end testing has an important role in testing the domain specific business level workflows over the integrated various systems. It is important not to confuse interoperability testing with end-to-end testing. Interoperability testing has a target specification/standard and aims to verify interoperability of the system components with respect to that specification. End-to-end testing, on the other hand, does not have a target specification and rather deals with the whole system architecture deployed with respect to the business requirements. Therefore multiple specifications, indirectly, may be covered under a fully deployed end-to-end testing environment.

Test Methodology

When a system is subject to conformance test, the test assertion version and SUT/Asset version are taken as unique test iteration labels and testing will be performed in a test cycle (see 0).

In each cycle, test results will be generated and delivered in the end of the cycle. If any major defects/bugs that affect the operation of the system, are found; they are reported to the vendor and considered as *stoppers*, and no further conformance testing will be performed on that product until those stopper defects/bugs are fixed. In the next cycle, it is assumed that the defect/bug is fixed and the conformance test is repeated.

Conformance testing methodology specifies how to evaluate if a product meets the necessary requirements of a specification, contract or regulation. In e-SENS, conformance testing verifies whether the e-SENS products perform in compliance with the defined eDelivery, e-Document , eID and Security standards proposed in WP6.B.

Interoperability testing methodology specifies if a set of products work together properly. In e-SENS, interoperability testing verifies whether all the e-SENS modules, that are candidate to be used in piloting in all domains, exchange and use information properly in terms of syntactic (Communication and exchanging data) and semantic (Interpreting the information exchanged meaningfully) aspects.

Test methodology is composed of the following activities:

- Creation of Test Assertions
- Creation of Adapters
- Creation of Test Cases
- Execution of the Tests
- Reporting (Test Deliverables)

Creation of Test Assertions

OASIS Test Assertions Specification[28] defines test assertions as follows:

“A test assertion is a testable or measurable expression for evaluating the adherence of an implementation (or part of it) to one or more normative statements in a specification”.

Test assertions (TAs) state the testable logics of a system under test. e-SENS test assertion template is compatible with OASIS Test Assertions Guidelines.

[28] http://docs.oasis-open.org/tag/model/v1.0/testassertionsmodel-1.0.html

The methodology is composed of steps that will be executed on Minder. For details, please see the e-SENS Test Assertion Guide[29].

1. For conformance testing, BB experts or providers of the inherited specification provide OASIS compliant test assertions based on the specifications or profiles of WP6 ABBs.
2. For interoperability testing: WP5 pilot domain experts determine the specific (non-generic) uses of the specification with respect to the target domain and generates OASIS compliant test assertions. These scenarios must include the interaction between the SBBs

Conformance test does not guarantee the interoperability of two systems and interoperability test cannot be a substitute to conformance testing. However, studies show that applying conformance tests at first reduces the cost and increases the successes of interoperability testing.[30] Therefore, it is recommended to conduct the conformance test for an SBB prior to interoperability testing.

Creation of Adapters

When a WP5 pilot domain adopts an SBB, which has not been conformance tested yet, and if it cannot reuse an existing adapter (i.e has a completely new/proprietary communication interface), then Pilot Domain Experts & Solution Providers (as in the role of Test Developer) must provide an adaptor implementation in order to be plugged into the conformance testing architecture. WP6 Conformance and Interoperability testing team provides all the necessary documentation to guide developers through the integration of SBBs to the conformance test environment. Moreover, the team may provide technical help for adapter development in terms of Minder connection.

Creation of Test Cases

After creating TAs and adapters, test designers can write test cases on Minder. Test cases represent either the whole or a part of a test assertion predicate interpreted in the MTDL that can be run on a concrete target (SUT). TAs that are related to each other are grouped under a *Test Group* (the testAssertionSet in OASIS TAML[31]).

Execution of the Tests

After the creation of test cases and mapping to actual SUTs, test cases are executed from the Minder management GUI. After each execution Minder creates logs and reports for that specific execution.

Reporting (Test Deliverables)

Test deliverables are the artifacts that are generated and given to the stakeholders participating in the conformance tests. (WP1/5/6 Leader, etc) The deliverables can be listed as follows:

1. ***Test Execution/Summary Report:*** After test cases are executed on Minder, the results of the test cases are documented in a report. On the report, the details of the test assertion, test run

[29] https://www.jol.nrw.de/bscw/bscw.cgi/d6002637/Test%20Assertion%20Guidelines_v0.1.docx

[30] https://wiki.oasis-open.org/tab/TestingPolicy

[31] http://docs.oasis-open.org/tag/taml/v1.0/testassertionmarkuplanguage-1.0.html

status, the total result of the test, etc. information is included. A sample eSENS test report can be seen from "Test Report for Test Assertion: Schema Samples[32]"

2. ***Test Results:*** Error and Execution Logs that are generated after executing test cases on Minder
3. ***Test Cases:*** Test cases that are derived from test assertions to be executed on Minder for compliance.

Test deliverables can be published by **WP6.A Deployment cluster** on Basecamp and/or BSCW server and can be classified as public or confidential. In case the document is classified as confidential, it will be a restricted publication.

Test Criteria

Test criteria include pass/fail, suspension and resumption criteria. The criteria are taken from OASIS TAM[33]

The completion criterion for conformance test iteration is the execution of the all test cases generated from test assertions in a test cycle. Test cases should cover all the test assertions and they should be in written in a sufficient level of detail. Test Assertions Guideline[34] should be referenced to write assertions.

Each test case execution can have two possible results: **Pass (***success***)** or **Fail**. Any additional warning will be logged in the report.

The overall ***PASS*** criterion for a test cycle is the *success* of all the ***mandatory*** test cases. The mandatory states of the test cases are derived from the *prescription level* field of the test assertions. There are three prescription levels defined in the OASIS TAM: i) mandatory, ii) permitted and iii) preferred. The *permitted* and *preferred* test assertions are considered as optional, and the **FAIL** state of their test cases cause the test cycle to ***PASS with warnings***.

Traceability

The conformance and interoperability activities produce results that need to be accessible to all the observers. In order to achieve a long-term sustainability of the test deliverables, an identification pattern for the test results is proposed.

Each test cycle takes test assertion details and SUT information (name, version) as an input. In order to achieve traceability for testing events, each testing activity must be labeled with the following identifiers:

- Test assertion set version
- Test assertion ID
- SUT/asset name and version
- Short result (success/fail)
- Report Reference
- Date

[32] https://mindertestbed.org:9000/viewReport?testRunId=1947&type=pdf

[33] http://docs.oasis-open.org/tag/model/v1.0/testassertionsmodel-1.0.html

[34] https://asset1.basecamp.com/2222566/projects/2624316/attachments/126775039/5dce0448e498d4240076cc3876a4bd380010/original?disposition=attachment

Testing Assurance Profiles

A testing assurance profile is the expression of the requirements to comply with the building block in order to work seamlessly within the context of pilots. The assurance profile of MSs piloting systems is determined with respect to the combination the tests that have been performed on those systems.

An assurance profile typically used as part of a regulation from a specific regulatory entity like eIDAS, who will only allow a specific type of Service to be used if it matches the assurance profile.
In this section four levels for grouping the assurance profiles (TAP #) for testing are defined. The high level assurance contains one profile (TAP 1) that includes all the three test types. The mid level assurance contains three profiles (TAP 2-4), where each profile is a pairwise combination of the three test types. In the basic level assurance, there are also three profiles (TAP 5-7), where each profile corresponds to one test type. It is crucial to note that all these types of testing are not substitutable but complementary to each other.

High Level Assurance

TAP 1: Conformance & Interoperability & End-to-End Testing

Mid Level Assurance

TAP 2: Conformance & Interoperability Testing

TAP 3: Interoperability & End-to-End Testing

TAP 4: Conformance & End-to-End Testing

Basic Level Assurance

TAP 5: Interoperability Testing

TAP 6: Conformance Testing

Low Level Assurance

TAP 7: End-to-End Testing

Annex V – AS4 Conformance Testing

The e-SENS AS4 profile was successfully tested according the testing procedure described in Annex IV. This section illustrates the conformance testing activities through the description of the conformance testing of SBBs to AS4 specifications. It is representative of the conformance testing required in e-SENS as it includes information flow from one gateway to another, requires document validation, signature validation, encryption and more for positive and negative scenarios.

In August 2015, e-SENS WP6, e-SENS WP5.1 and CEF eDelivery team collaboratively initiated the creation of the Conformance Test Assertions for the e-SENS AS4 profile: 48 Test Assertions were released on 20th of August, 2015.

Afterwards, Minder team started to develop adapters between Minder and Domibus gateway developed in collaboration with e-SENS and e-CODEX projects. An adapter composed of two sides naming *Generic side* and *SUT specific side* (See Figure 32). Generic side of an adaptor is responsible for connecting SUT to Minder and requires Minder expertise. Aside from SUTs that are only assets, a SUT, like an AS4 gateway, takes inputs and produce outputs. Hence, SUT specific side of an adapter need SUT experts who declare inputs/outputs and know communicating with the SUT.

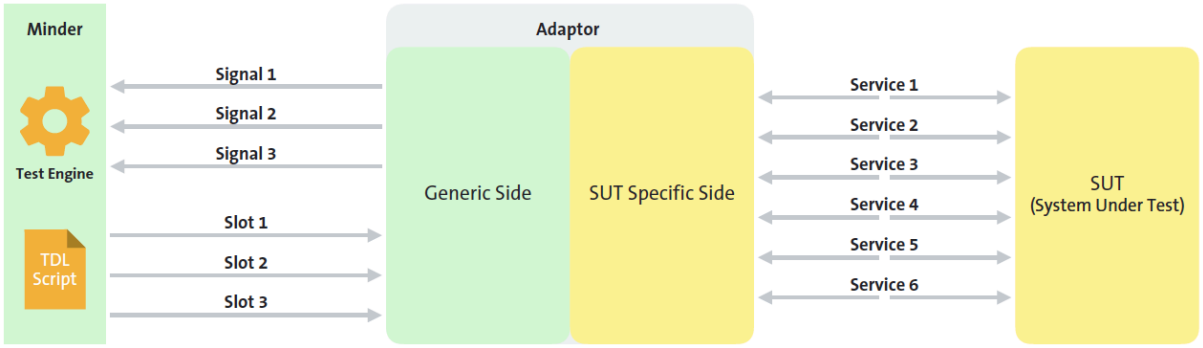

Figure 32- Connecting an SUT to Minder over an Adaptor

An AS4 gateway has a backend end-point, which is implementation specific and receives/sends documents from/to backend system and an AS4 end-point, which is implemented according to the e-SENS AS4 profile, sends/receives AS4 messages to/from other AS4 gateway. For this reason, two adaptors needed to connect AS4 gateway to Minder: Backend Adaptor, which is implementation specific; AS4 Adaptor, which is common for all e-SENS AS4 profile implementations (See Figure 33).

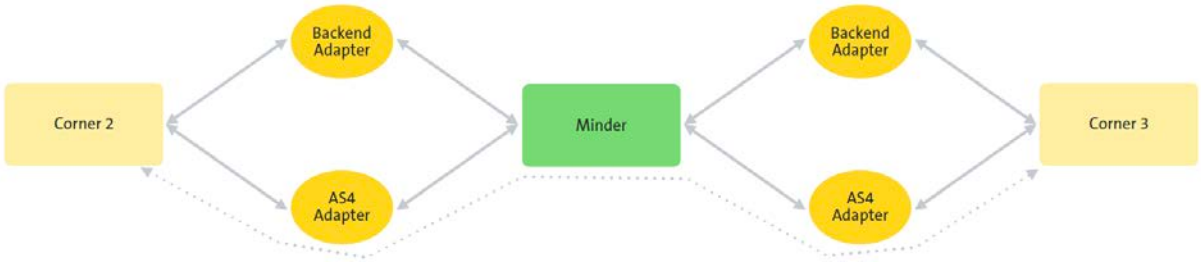

Figure 33- Connecting an e-SENS AS4 gateway to Minder over Backend Adaptor and AS4 Adaptor

Corner 2 and Corner 3 implies an e-SENS AS4 Gateway implementation. For Conformance Testing, both Corner 2 and Corner 3 are the same AS4 implementation; whereas for Interoperability Testing Corner 2 and Corner 3 are two different AS4 implementations.

After finalising the developments of adaptors, Minder team wrote test case scripts in Minder Test Definition Language (MTDL) according to the e-SENS AS4 Test Assertions using Minder Web interface. In addition, Minder team deployed two Domibus AS4 GW instances as Corner 2 and Corner 3; connected them to the Adapters, and ran test scripts for Domibus implementation. The first conformance test results were generated for Domibus and it was also a proof to show the abilities of Minder.

In July 2015, an internal discussion had been started on developing more generic AS4 adaptors for upcoming vendors, in order not to code implementation specific Backend Adaptors which may take one or two weeks. Since all gateway implementations are common to understand an AS4 message, just for testing, implementations would communicate with a backend system over AS4 too. According to this idea, each implementation would need to configure a pre-defined pMode and a shell script that is used for receiving backend messages in AS4 format from AS4 end-point, converting this AS4 message to implementation specific backend message and forwarding to the backend end-point of the implementation. As a result, Minder team implemented an intermediary product called Kerkovi as an e-SENS generic AS4 Conformance and Interoperability Bridge that achieves connectivity between Minder and vendor's AS4 implementations in a very simple manner (See Figure 34).

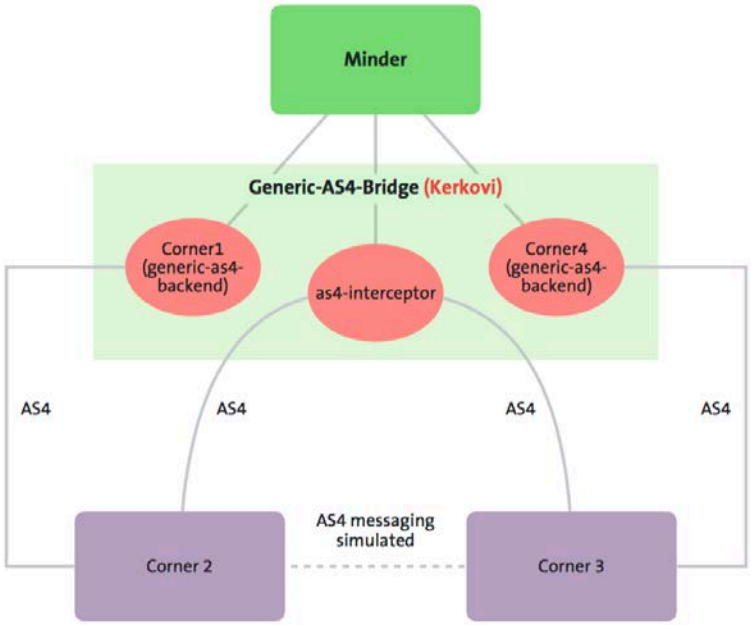

Figure 34- Connectivity between Minder and an AS4 implementation using Kerkovi

Kerkovi consists of three adapters; two generic national backend simulators and one AS4 interceptor. The backend adapters are capable of sending AS4 messages as backend submission messages to the AS4 gateways. They can also receive delivery, submission result and notification messages. Kerkovi is responsible for tracking the addresses of the gateways with respect to the party ID's and perform forwarding of messages with respect to the addresses it resolves from the party ID's. In this way, Kerkovi removes the adaptor development effort on implementation specific backend adapters for each new implementation. As a result, an AS4 implementation can be easily connected to Minder just by i) configuring pMode according to the pre-determined pModes definitions and ii) writing a shell script that receives backend messages from AS4 end-point of the implementation as an AS4 message, convert this AS4 message to implementation specific backend message and forwards to backend end-point of the implementation. Once an AS4 implementation is connected to Minder using Kerkovi, both

conformance and interoperability testing activities are handled easily and automatically using Minder. Detailed information can be found in Kerkovi web site[35].

After the completion of the AS4 Conformance Tests of Domibus in August 2015, e-SENS made the first call for e-SENS AS4 conformance testing in December 2015. The external vendors that applied with their products and completed the conformance testing activities successfully are “Holodeck B2B AS4 GW” and “Flame Message Server”,“IBM Advanced Communication Gateway”, “EESSI AS4.NET”, “Laurentius”, “Mendelson” and “RSSBus”. The Conformance testing of the “ADES” and “Integration Cloud” products are still in progress. For this BB, Interoperability Test Assertions have been created for the most common usages of the e-SENS AS4 specification by BB experts and applied for the aforementioned products of vendors. The future cycles of conformance and interoperability testing are going to be applied in Minder and managed by CEF.

[35] https://mindertestbed.org:15000

Annex VI – Contributors

Deliverable 6.6

Name	Surname	Organisation	Country	Report	EIRA Governance	WP6 Management (Architectural Board)	SGCC 6.A - Deployment	Pilot deployment support	BB LCM Process definitions and setup	BB LCM execution	Conformance and Interoperability testing	Development of Conformance testbed	SGCC 6.B - Architecture	EIRA Metamodel and Governance	EIRA BB Development	BB LCM execution
Elif	Üstündağ Soykan	TUBITAK	Turkey	■				■	■	■				■		■
Burcin	Bozkurt	TUBITAK	Turkey	■				■	■	■				■		■
Edona Fasllija	Fasllija	TUBITAK	Turkey						■							
Muhammet	Yildiz	TUBITAK	Turkey						■							
Melis	Cetinkaya	TUBITAK	Turkey						■							
Cagatay	Karabat	TUBITAK	Turkey	■		■	■									
Borka	Jerman-Blazic	JSI	Slovenia											■		■
Carmen	Rotuna	ICI Bucharest	Romania					■		■						■
Carmen Elena	Cirnu	ICI Bucharest	Romania											■		■
Radu	Boncea	ICI Bucharest	Romania					■		■						■
Rui	Maia	INOV	Portugal											■		
António	Leal	INOV	Portugal											■		
Elisabete	Carreira	INOV	Portugal											■		
Tomasz	Kawecki	ILiM	Poland													■
Erland	Bergheim	DIFI	Norway					■			■					
Steinar	Cook	DIFI	Norway					■			■					
Anna-Lis	Berg	DIFI	Norway	■		■										
Klaus Vilstrup	Pedersen	DIFI	Norway	■	■	■	■		■				■	■		
Jon	Ølnæs	DIFI	Norway					■								
Francois Xavier	Fontaine	LIST	Luxembourg	■	■									■	■	■
Eric	Grandry	LIST	Luxembourg	■	■	■							■	■	■	■
Uwe	Roth	LIST	Luxembourg											■		■
Jean Francois Merche	Merche	LIST	Luxembourg							■				■		■
Andrea	Atzeni	IT-Polito	Italy												■	■
Giovanni Paolo Sellitt	Sellitto	AGID	Italy					■								■
Diana	Berbecaru	AGID	Italy											■		■
Gretar Thor Gretarss	Gretarsson	Advania	Iceland												■	
Sigurdur	Masson	Advania	Iceland												■	
Jerry	Dimitriou	UPRC	Greece					■		■				■		
Panagiotis	Nicolaou	UPRC	Greece													■
Flora	Malamateniou	UPRC	Greece					■						■		■
Athanasios	Siachoudis	AUTH	Greece								■					
Ioannis	Pangalos	AUTH	Greece						■							
Sören	Bittens	Fraunhofer	Germany						■						■	
Olaf	Rode	Fraunhofer	Germany												■	
Jörg	Apitzsch	Governikus	Germany					■		■					■	■
Gregor	Thomas	JM NRW	Germany			■										
Pim	Van der Eijk	JM NRW	Germany													■
TUGraz		TUGraz	Austria					■		■					■	■
Austria A-SIT		A-SIT	Austria							■					■	■
Masi	Massimiliano	Tiani Spirit	Austria					■							■	■

Deliverable 6.3

Name	Surname	Organisation	Country	Report	eInteraction	eDelivery	Addressing of End Entities	Message exchange protocol	Capability Lookup	Location Lookup	Backend Integration	End-to-End Services	eDocument	Document Profiling	Document Provisioning	Processes	Semantics	Semantic Mapping Services	Terminology Server
Elif	Üstündağ Soykan	TUBITAK	Turkey																
Edona	Fassllija	TUBITAK	Turkey																
Burcin	Bozkurt	TUBITAK	Turkey																
Vural	Celik	TUBITAK	Turkey																
Muhammet	Yildiz	TUBITAK	Turkey																
Melis	Cetinkaya	TUBITAK	Turkey																
Cagatay	Karabat	TUBITAK	Turkey																
Oktay	Adalier	TUBITAK	Turkey																
Borka Jerman	Blazic	Ljubljana University	Slovenia																
Carmen	Rotuna	ICI Bucharest	Romania																
Radu	Boncea	ICI Bucharest	Romania																
Rui	Maia	INOV	Portugal																
Tomasz	Dębicki	ILIM	Poland																
Tomasz	Kawecki	ILiM	Poland																
Giovanni Paolo	Sellitto	ANAC - AVCP	Italy																
Andrea	Atzeni	IT-Polito	Italy																
Antonio	Lioy	IT-Polito	Italy																
Stephanie	Brichant	Escher group	Ireland																
Damien	Magoni	Escher group	Ireland																
Cristian	Olariu	Escher Group	Ireland																
Jerry	Dimitriou	UPRC	Greece																
Panagiotis	Nicolaou	UPRC	Greece																
Heiko	Vainsalu	EISA	Estonia																
Margus	Värton	EISA	Estonia																
Riin	Saermae	EISA	Estonia																
Mads	Hjorth	SSI	Denmark																
Sören	Bittens	Fraunhofer	Germany																
Jörg	Apitzsch	Governikus GmbH	Germany																
Torsten	Niedzwetski	JM NRW	Germany																
Iva	Milutinovic	JM NRW	Germany																
Pim	Van der Eijk	JM NRW	Germany																
Thomas	Zefferer	ARGE e-SENS.AT	Austria																
Bojan	Suzic	ARGE e-SENS.AT	Austria																
Herbert	Leitold	ARGE e-SENS.AT	Austria																
Masi	Massimiliano	Tiani Spirit GmbH	Austria																
Klaus Vilstrup	Pedersen	DIFI	Norway																
Contribution																			
Review																			

Name	Surname	Organisation	Country	eSignature	Signature-Creation	Signature-Verification	EU e-signature standards framework	Mobile eSignature	eID	eID-Mobile	eID-SAML	eID-QAA	Mobile eID	Attribut provider	Attribute Provider - Format	Attribute Provider - Protocol	Tracebility	Auditing and Logging	Timestamping	Trust Services	Trust Network - MRC	Trust Network - PKI	Trust Network - Trust List	Web Service Trust Model
Elif	Üstündağ Soykan	TUBITAK	Turkey																					
Edona	Fassllija	TUBITAK	Turkey																					
Burcin	Bozkurt	TUBITAK	Turkey																					
Vural	Celik	TUBITAK	Turkey																					
Muhammet	Yildiz	TUBITAK	Turkey																					
Melis	Cetinkaya	TUBITAK	Turkey																					
Cagatay	Karabat	TUBITAK	Turkey																					
Oktay	Adalier	TUBITAK	Turkey																					
Borka Jerman	Blazic	Ljubljana University	Slovenia																					
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Radu	Boncea	ICI Bucharest	Romania																					
Rui	Maia	INOV	Portugal																					
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Tomasz	Kawecki	ILiM	Poland																					
Giovanni Paolo	Sellitto	ANAC - AVCP	Italy																					
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Damien	Magoni	Escher group	Ireland																					
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Margus	Värton	EISA	Estonia																					
Riin	Saermae	EISA	Estonia																					
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Herbert	Leitold	ARGE e-SENS.AT	Austria																					
Masi	Massimiliano	Tiani Spirit GmbH	Austria																					
Klaus Vilstrup	Pedersen	DIFI	Norway																					
Contribution																								
Review																								

Name	Surname	Organisation	Country	Report	Architecture	eDelivery	Addressing of End Entities	Message Exchange	Capability Lookup	Service Location	Backend Integration	eDocument	Document Provisioning	Document Business Envelope	Document Container	Processes	Business Process Methodology	Business Rules Definition Methodology	Semantics	Semantic Mapping Service	Terminology Service	eSignature	Signature Creation	Signature Validation	eSignature/eID Mobile
Elif	Üstündağ Soykan	TUBITAK	Turkey	C																		C	C	C	C
Burcin	Bozkurt	TUBITAK	Turkey	C								C	P	P	C	C	C	C							
Muhammet	Yildiz	TUBITAK	Turkey	C		C		C	C	C	C														
Melis	Cetinkaya	TUBITAK	Turkey	C		C	C	C	C	C	C														
Cagatay	Karabat	TUBITAK	Turkey	C																		C	C	C	C
Oktay	Adalier	TUBITAK	Turkey	C																		P	P	P	P
Carmen	Rotuna	ICI Bucharest	Romania					C				C	P	C	P										
Radu	Boncea	ICI Bucharest	Romania									C	C	C	C	C	C	C							
Rui	Maia	INOV	Portugal		C																				
Tomasz	Kawecki	ILiM	Poland													C	C	C	C	C	C				
Giovanni Paolo	Sellitto	ANAC - AVCP	Italy																C	C	C				
Andrea	Atzeni	IT-Polito	Italy																						
Antonio	Lioy	IT-Polito	Italy																						
Jerry	Dimitriou	UPRC	Greece								C								C	C	C				
Panagiotis	Nicolaou	UPRC	Greece									C	C	P	P										
Yiannis	Salmatzidis	AUTH	Greece																						
Ioannis	Rekanos	AUTH	Greece																						
Ioannis	Pangalos	AUTH	Greece																						
Athanasios	Migdalas	AUTH	Greece																						
Achilleas	Papoutsis	AUTH	Greece																						
Sören	Bittens	Fraunhofer	Germany																						
Olaf	Rode	Fraunhofer	Germany																						
Jörg	Apitzsch	Governikus GmbH	Germany																						
Iva	Milutinovic	JM NRW	Germany			C	C	C	C	C	C														
Pim	Van der Eijk	JM NRW	Germany			C	C	C	C	C	C														
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Masi	Massimiliano	Tiani Spirit GmbH	Austria																						
Francois Xavier	Fontaine	LIST	Luxembourg	C	C	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Eric	Grandry	LIST	Luxembourg	C	C	P	P	P	P	P	P	P	P	P	P	C	C	C	P	P	P	P	P	P	P
Klaus Vilstrup	Pedersen	DIFI	Norway	C	C	P	P	P	P	P	P	P	P	P	P	C	C	C	P	P	P	P	P	P	P

Contribution
Participation

Name	Surname	Organisation	Country	eID	Authentication Exchange Protocol	Quality Authentication	Authentication Exchange Forward	FutureId	Attribut provider	Attribute Exchange Protocol	Attribute Exchange Forward	Traceability and Non-Repudiation	Timestamping	Evidence Emitter	Trust Establishment	Trust Network - Mutual recognized Certificates	Trust Network - PKI	Trust Network - Trust service Status List	Web Service Trust Model	Conformance and Interoperability Testing	Conformance and Interoperability Testbed	Content Validation Provider	Test Asset Classification and Registry	Test Assertion Provisioning
Elif	Üstündağ Soykan	TUBITAK	Turkey																					
Burcin	Bozkurt	TUBITAK	Turkey																					
Muhammet	Yildiz	TUBITAK	Turkey																					
Melis	Cetinkaya	TUBITAK	Turkey																					
Cagatay	Karabat	TUBITAK	Turkey																					
Oktay	Adalier	TUBITAK	Turkey																					
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Radu	Boncea	ICI Bucharest	Romania																					
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Tomasz	Kawecki	ILiM	Poland																					
Giovanni Paolo	Sellitto	ANAC - AVCP	Italy																					
Andrea	Atzeni	IT-Polito	Italy																					
Antonio	Lioy	IT-Polito	Italy																					
Jerry	Dimitriou	UPRC	Greece																					
Panagiotis	Nicolaou	UPRC	Greece																					
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Ioannis	Pangalos	AUTH	Greece																					
Athanasios	Migdalas	AUTH	Greece																					
Achilleas	Papoutsis	AUTH	Greece																					
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Olaf	Rode	Fraunhofer	Germany																					
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Thomas	Zefferer	ARGE e-SENS.AT	Austria																					
Bojan	Suzic	ARGE e-SENS.AT	Austria																					
Herbert	Leitold	ARGE e-SENS.AT	Austria																					
Johannes	Feichtner	ARGE e-SENS.AT	Austria																					
Sandra	Kreuzhuber	ARGE e-SENS.AT	Austria																					
Alexander	Marsalek	ARGE e-SENS.AT	Austria																					
Masi	Massimiliano	Tiani Spirit GmbH	Austria																					
Francois Xavier	Fontaine	LIST	Luxembourg																					
Eric	Grandry	LIST	Luxembourg																					
Klaus Vilstrup	Pedersen	DIFI	Norway																					

Contribution
Participation