



SEAL

Student and Citizen Identities Linked

D6.4 Report on sustainability and road-mapping

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List of Acronyms

Abbreviation / acronym	Description
AARC	Authentication and Authorisation for Research and Collaboration
API	Application Programming Interface
AML	Anti-money laundering
ARI	Atos Research and Innovation
AXN	Attribute Exchange Network
BDS	Big Data & Security
BPA	Blueprint Architecture
CA	Certificate Authority
CAPEX	Capital Expenditure
CEF	Connecting Europe Facility
CTF	Counter terrorism financing
DiSSCo	Distributed System of Scientific Collections
DUMA	University of Málaga identity repository
Dx.y	Deliverable number y belonging to WP x
EBSI	European Blockchain Partnership
EC	European Commission
ECCA	European Campus Card Association
EDSSI	European Digital Student Services Infrastructure
eduGAIN	EDUcation Global Authentication INfrastructure
eduroam	EDUcation ROAMing
eID	Electronic IDentification
eIDAS	Electronic Identification Authentication and trust Services
eMRTD	Electronic Machine-Readable Travel Document
EOSC	European Open Source Certificate
EOSR	EBSI Onboarding Service Registry
ePassport	Electronic Passport
ESC	European Student Card
ESMO	eIDAS-enabled Student Mobility
ESSIF	European self-Sovereign Identity Framework

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Abbreviation / acronym	Description
EU	European Union
EUNIS	European University Information Systems
EUPL	European Union Public License
EWP	Erasmus Without Paper
GDPR	General Data Protection Regulation
GN3	GÉANT3
H2020	Horizon 2020
HEI	Higher Education Institution
IATA	International Air Transport Association
IBAN	International Bank Account Number
ICAO	International Civil Aviation Organization
IdP	Identity Provider
ILN	Identity Linking Network
IPR	Intellectual Property Rights
IPV	Identity Proofing and Verification
KPI	Key Performance Indicator
LoA	Level of Assurance
KYC	Know Your Customer
mDLs	Mobile Driving Licenses
MS	Member State
NREN	National Research and Education Network
OIDC	OpenID Connect
ORCID	Open Researcher and Contributor Identifier
PDF	Portable Document Format
PEPS	Pan European Proxy Service
PESC	Postsecondary Electronic Standard Council
PKIX	Public Key Infrastructure X.509
QualiChain	Decentralised Qualifications Verification and Management for Learner Empowerment, Education Reengineering and Public Sector Transformation
REFEDS	Research and Education FEDerations
SAML	Security Assertion Markup Language
SCHAC	SCHema for ACademia

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Abbreviation / acronym	Description
SelfKey	Self-Sovereign Identity for more Freedom and Privacy
SSI	Self-Sovereign Identity
STORK	Secure identity across bordeRs linKed
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAR	Trusted Accreditation Registry
TIR	Trusted Issuers Registry
TRS	Trusted Schemas Registry
UJI	Jaume I University
UMA	University of Málaga
uPort	Distributed Ledger Technology based identity (now serto)
URN	Uniform Resource Name
VC	Verifiable Claims
VN	Verification Network
W3C	World Wide Web Consortium
WP	Work Package

1. Executive Summary

The present document outlines the sustainability and road-mapping of SEAL project with the focus on use cases in the education domain not defined at the beginning of the project, possible adoption in other sectors and evolution of SEAL results.

This deliverable approaches the sustainability factors and road-mapping by accomplishing an assessment of SEAL functionalities in an ‘external’ context. Therefore, SEAL positioning described in this document includes the assessment of the use case which was not defined at the beginning of the project for the education domain, as well as the possible SEAL-based solutions for the other sectors and the update of opportunities and threats, based on the SWOT analysis from the previous deliverable D6.2.

Likewise, as it was already mentioned in D6.2 “Maintenance and sustainability planning”, positioning SEAL after project includes branding issues with a creation of a name disconnected from the project itself. Partners voted “MyIDs” as a brand name for such service and estimated the costs of registering it as trademark. In addition to these costs, this deliverable, D6.4, details the cost analysis of operating and maintaining SEAL and the list the benefits (in non-accounting terms) as well.

“MyIDs” service is the main exploitable result of SEAL project, with its user-centric identity management technology, ability to link identities from various identity provider sources, and finally issue secure and trustworthy Credentials based on these (linked) identities, or even derive new identities from the combinations of credentials coming from various sources, all under direct control of the person owning the data. For this reason, as pointed out in D6.2, sustainability of the services resulting from SEAL project requires also making decisions outside the scope and lifetime of the project. For this reason, the individual partners plan for sustainability of SEAL project are included in Annex A of this deliverable.

Furthermore, the action plan, which is mainly based on data provided by partners in their individual exploitation and sustainability plans, is stipulating how SEAL community will be promoted, in parallel by HEI partners of the project, in the existing relevant educational domain communities. Higher education institution (HEI) that participate as partners in the project are committed to include operation of SEAL service as a part of their e-ID management and IT system maintenance activities, and there is no additional budget allocated for this. Nevertheless, this will be the seed for the community that will promote project results, as the growth of SEAL community and its convergence and alignment with the other initiatives is crucial for success of SEAL projects results.

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2. Introduction

2.1. Purpose of the document

The present document focuses on sustainability of SEAL project results, as a building block for other projects and services in the educational realm, as well as a contribution to projects in other sectors that could benefit from identity linking mechanisms.

The services resulting from SEAL project require an infrastructure to run on, so the cost for running it will also be presented, together with the list of benefits that can be obtained from running such infrastructure and services.

The final purpose of the document is describing a strategy and an action plan in order to incrementally increase uptake of the project results in the future, both inside and outside the education realm.

2.2. Context of this deliverable

Inside of SEAL project, activity 6 is clustering all efforts that should lead to a wider and faster adoption of SEAL project results, with the identity linking service branded as “MyIDs” as the main result. In this sense, we could say that the context of this deliverable is to serve as a bridge between the work done in the project and the work yet to be done after the project ends. Besides several descriptive parts, that recapitulate and validate what was already stated in the previous deliverables (most notably D6.2), this deliverable also brings new assumptions that need to be validated after the project ends.

As the project itself is placed in a greater context that, for example, depends on evolution of Erasmus+ and Connecting Europe Facility (CEF) programmes, this deliverable is also placing emphasis on external dependencies, including analysis of business cases and possible uptake outside educational domain.

There are several projects that rely on trustworthy digital identities with high level of assurance (LoA), such as national eID cards (that also serve as notified eID in eIDAS framework) or ePassports, but SEAL ability to link identities from these high LoA with diverse other identity providers and generate new ones, derived from data gathered from educational institutions, can open many opportunities for a variety of stakeholders.

We should also mention the context and the future of eIDAS regulation and infrastructure, together with the eduGAIN federation, being the two main sources of identity attributes for SEAL. In the same manner context and future of EBSI is also intrinsically linked to the sustainability of SEAL, as it will, most probably, become the future support infrastructure for the linking of different SSI credentials. Therefore, context and focus of this deliverable, when it comes to infrastructures, is to look at the roadmap and the predictions for a convergence with these important initiatives.

On the demand side, service providers such as HEI, are driven by the new Erasmus guidelines that clearly call for a full digitalisation of the processes, therefore in need for the kind of digital identities that SEAL can provide. In this direction, context of this deliverable is alignment with the current schedule and Erasmus deadlines. All HEIs need to be connected to the EWP network before June 2021 for managing Learning Agreements and renewing Inter Institutional Agreements. While 2021/2022 academic term is a transitional one, the previous requirement will be compulsory for 2022/2023 academic term, when all LAs for student mobilities will have to be managed on-line (OLA) over the

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EWP network. In addition, all IIAs should have been renewed electronically using the EWP network. These external deadlines pose also timeline for SEAL roadmap and we conclude therefore that this deliverable must be placed in a wider context of external events, where digital identity is becoming a foundational part of digital transformation processes in educational domain. A clear and trustworthy identification of the person that is involved in the student mobility processes is an absolute requirement. Having a combination of credentials from government issued eID and academic identities for a given person increases the level of trust on the received information.

2.3. Structure of the document

Besides this introductory and methodology chapters, this document is structured in three major chapters:

Chapter 4 presents the cost analysis for both operating and maintaining the SEAL service infrastructure and list the benefits of SEAL results in non-accounting terms.

Chapter 5 describes SEAL project positioning of use cases in the education domain not defined at the beginning of the project, adaptation of SEAL results to other sectors, and the assessed opportunities and threats.

Chapter 6 presents the road-mapping, which consists in the different actions that conforms the actual plan for future uptake and backing by relevant stakeholders.

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3. Methodology

Deliverable D6.2 and D6.4 have been written in parallel and rely on different but intertwined methodological approaches. The main methodologies relied on common actions related to market and trend analysis, typical for the exploitation of results in collaborative projects, while road-mapping, which is the focus of this deliverable also looked at the wider business planning context.

Deliverable D6.2 “Maintenance and sustainability planning”, which was delivered three months earlier, focuses on analysis of internal sustainability factors and exclusively on the educational domain. It also makes assumptions about alternative paths to follow once the project finishes, based on strengths and weaknesses obtained from results analysis or partners plans. This deliverable D6.4 “Report on sustainability and road mapping” focuses more on external factors presenting opportunities and threats, and project SEAL results as a possible solution to be applied to other domains, as well as the cost analysis of operating and maintaining SEAL. Road-mapping exercise is placed in the mid to long term planning.

Initial five steps of the methodology are therefore common for both deliverables, although results of some steps are more applicable to one or another report.

STEP 1: Identify what outcomes we need to sustain over time and what strategies does the consortium or individual partners must implement to accomplish sustainability of their (part of) project outcome. While initial results of this step are included in D6.2, partners also explored the possibility of results uptake in other domains, different than education, and the feasibility to transfer this technology, which is reported in this deliverable. A knowledge repository is created to collect all information related to each single piece of code, whether it is module, interface, or small software component, with an overview of Intellectual Property Rights (IPR) issues, integration constraints or guidelines, repository link¹ (on GitHub) and other useful information.

STEP 2: Identify what resources are required (investment, training technology, partners) to sustain the results (or parts of it) overtime. This is related to individual investment and exploitation plans, included in D6.4 as it is delivered at the end of the project. These plans are presented in Annex A and their outcome have been important to decide on alternative paths to follow and ultimately to make roadmap.

STEP 3: Create other business cases, validate assumptions, select optimal alternatives that fit all partners motivations and planning. Use cases provide a rationale for business cases, even if these are based on further fundraising or grant-seeking activities. While the need to communicate SEAL value propositions, purpose, and evolution is present in both deliverables, in D6.4 we will be targeting a wider audience, after additional opportunities and threat analysis has been done.

¹ <https://github.com/EC-SEAL>

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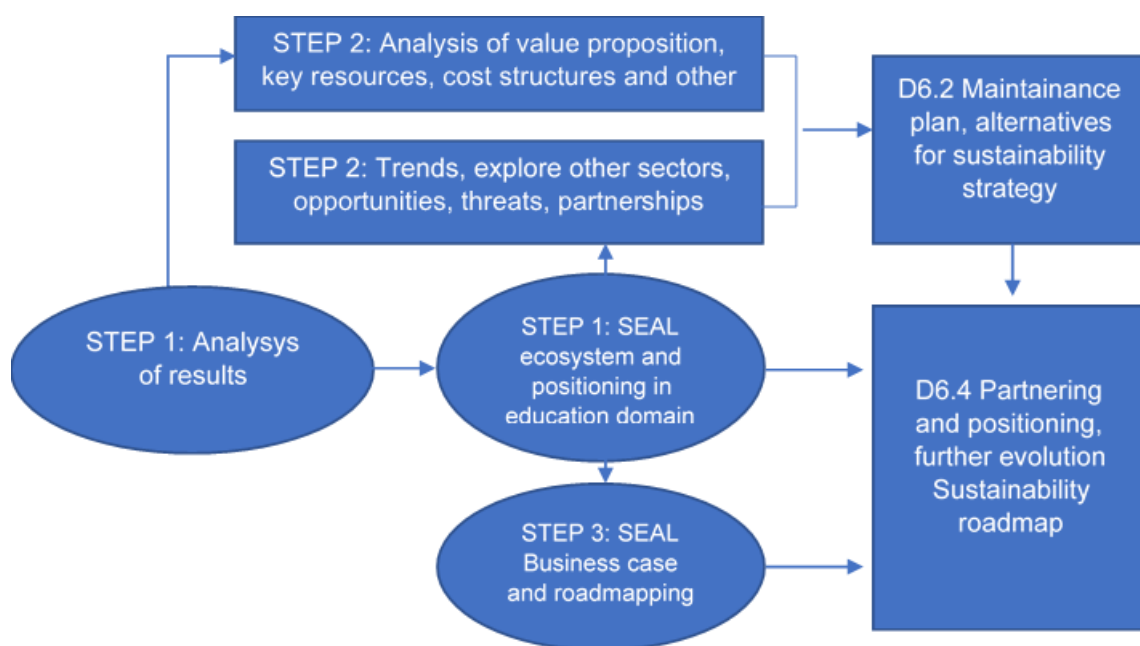


Figure 1: Methodology used for D6.2 and D6.4

3.1. Related Projects and Methodologies

eduGAIN is one of the core elements of SEAL, it includes over 2800 identity providers in their ecosystem, allowing broader access to electronic identification for HEIs at reduced cost. As part of the GÉANT 2020 Framework Partnership Agreement (FPA), eduGAIN receives funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No. 856726 (GN4-3).

GEANT has also participated or is involved in projects such as MyAcademicID, NGI Trust and LifeSciences AAI and EDSSI. There are also supporting other communities from educational domain. REFEDS (the Research and Education FEDerations group) is another group managed by GÉANT, who provide secretariat support they analysed the feasibility of intersection of two eID ecosystems, resulting for example in guidelines and best practices for mapping social media profiles to a set of attributes used in education (for research and scholarship services).

In a similar way, in Stork project there was an attempt to link eduGAIN and eIDAS node (called PEPS at that time). Two use cases that have been named “Stork user visiting eduGAIN services” and “eduGAIN user visiting STORK services” made an use of so called eduPEPS, but there was no maintenance afterwards, so the attempt to link these two ecosystems was abandoned. However, this initiative is again trying to gain momentum from MyAcademicID and EDSSI projects, as using a given MS eIDAS node (Sweden for EDSSI, Greece for SEAL) for connecting government provided identities to academic services has proven not to be the most user-friendly way.

MyAcademicID, which is a sort of “twin project” to SEAL, has defined the European Student Identifier (ESI) as a derivation from the one defined by the European Student Card, currently deployed by universities that participate in ESC. The ESC resembles IBAN for banks (that is used in bank Id

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ecosystem) and has four components (country, region, PIC of university and student nr). The shortcoming is that it relies on PIC number for universities that can be replaced in the future. Therefore, in MyAcademicID and EDSSI concluded, with input from the community, that using a URN, as specified in SCHAC personalUniqueCode attribute, was a better and easier to implement way forward.

The Authentication and Authorisation for Research and Collaboration (AARC) initiative is relatively old, dating back to 2015, but since then had several follow-ups. A second phase of the project (AARC2) that started in May 2017, was aiming at piloting an integrated authentication and authorisation framework, while AARC2 is recent H2020 project that finished in April, whose results have been transferred to GEANT where the blueprint architecture (BPA) has been adopted.

In Netherlands, SRF (which is the national NREN) has been contacted by SEAL partners to compare and analyse concept of eduID that acts as self-created ID, but with a possibility to increase assurance by involving authoritative sources.

SEAL also took recommendations of report that has been prepared by the European Campus Card Association (ECCA) as part of a Consultation Process on the Development of a Proposal for a Trusted Student Identification Framework (Student eID Project). One of these recommendations is related to remote identity verification services, which has also been in the scope of projects such as ESMO, as the need was identified after analysing the potential use cases ESMO opened by enriching the data set that could be consumed with additional data sources other than eIDAS IdPs.

Finally, we can also mention QualiChain project that focuses more specifically on a set of baseline services in educational sector related to any type of credentials from Awards and Qualifications to services such as Competency Management including Recruitment. The proposed solution was piloted through scenarios that include lifelong learning, or smart curriculum design, and use of SEAL linked identities was also tested .

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4. Cost analysis of operating and maintaining SEAL

The SEAL Platform provides a Credential based authentication through an identity that binds together person’s civil and academic attributes. The Digital Identity Credentials issued by SEAL VC Issuer may be verifiable credentials, i.e. trustworthy with reference to W3C standards, and indexed to a trust identity anchor (an eIDAS eID or an e-passport). As a result, SEAL linked identity offers a high level of assurance while at the same time the SEAL platform allow users to selectively present and identify with parts of identity, formed from a limited set of attributes. These features of SEAL platform make it suitable for a Higher Education Institution (HEI) to use it:

- a. As a “third party” authentication scheme for ERASMUS incoming students and participants in other education and research activities developed in collaboration with other HEIs partners and external partners (to replace current Social Media-based third-party authentication practices)
- b. As a complete solution for small scale Institutions that have not developed yet their own Identity Access Management systems.

This section presents in depth this option in terms of: a) SEAL Platform costs which allow SEAL to serve as a reference sustainable solution for third party authentication, b) obtained benefits for the HEI adopters of SEAL Linked Identity-based authentication.

4.1. Cost analysis

The SEAL Platform is a software construct with several components but compact at the deployment level. The current version runs in a VM provided by GRNet, one of the partners of the SEAL project. A full production infrastructure would require a few more VMs, for redundancy, separation of Credential Issuance from the Verification etc. In this section, we outline the different cost components for making SEAL Platform a sustainable production solution in a 3-years’ time frame.

The proposed Cost Model starts with two assumptions:

1. SEAL project has received EU funding to develop and build the SEAL platform. This funding covers the necessary capital expenditures (CAPEX) for the initial development of the Platform.
2. The cost model we have developed primarily addresses the operational expenses for running the system assuming that SEAL Platform serves the needs of 4 Universities which are SEAL partners and that it is able to recruit 5 new adopters (HEIs) per year
3. At the same time, the model calculates the CAPEX costs for the upgrade of the SEAL platform, which are necessary to ensure a smooth adaptation of SEAL platform to a fast-changing innovation landscape.

Cost Model Components	
SEAL Platform Hosting	OPEX
SEAL Platform and Service Maintenance	OPEX
Operation	OPEX
Marketing and Community Building	OPEX

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Further Development - Versioning (CAPEX)	CAPEX
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We present below the Cost Model Calculation for each of the above Cost Categories

OPEX

SEAL Platform Hosting

SEAL Platform	Year 1	Year 2	Year 3	Years 1-3
SEAL Platform Hosting (OPEX)				
Main Server (OPEX H1)	0.00	0.00	1,200.00	1,200.00
Redundancy Server (OPEX H2)	600.00	900.00	1,200.00	2,700.00
Second Server for separating the issuance from verification of Credentials (OPEX H3)	600.00	900.00	1,200.00	2,700.00
Servers for Development (OPEX H4)	0.00	0.00	0.00	0.00
EBSI interconnection cost (OPEX H5)	0.00	0.00	0.00	0.00
Hosting Services:10% of OPEX H1-4	180.00	270.00	540.00	990.00
Total Hosting	1,380.00	2,070.00	4,140.00	7,590.00

SEAL Platform and Service Maintenance

SEAL Platform	Year 1	Year 2	Year 3	Years 1-3
SEAL Platform and Service Maintenance (OPEX)				
SEAL platform: 2 person-months per Year x 4000 EUR/month (OPEX M1)	8,000.00	8,000.00	8,000.00	24,000.00
SEAL Platform Maintenance Cost (per partner University): 500 EUR (assumption: SEAL grows by recruiting 5 new partners per year) (OPEX M2)	4,500.00	7,000.00	9,500.00	21,000.00
Project Management: 10% of OPEX M1-2 (OPEX M3)	1,250.00	1,500.00	1,750.00	4,500.00
Other Cost: 5% of OPEX M1-3 (OPEX M4)	687.50	825.00	962.50	2,475.00
Total Maintenance	14,437.50	17,325.00	20,212.50	51,975.00

Operation

Operation (OPEX)				
SEAL Services Operation Cost (per partner University): 1000 EUR (assumption: SEAL grows by recruiting 5 new partners per year) (OPEX O1)	9,000.00	14,000.00	19,000.00	42,000.00
Project Management: 10% of OPEX O1 (OPEX O2)	900.00	1,400.00	1,900.00	4,200.00
Other Operation Cost: 5% of OPEX O1-2 (OPEX O3)	495.00	770.00	1,045.00	2,310.00
Total Operation	10,395.00	16,170.00	21,945.00	48,510.00

Marketing and Community Building

SEAL Platform	Year 1	Year 2	Year 3	Years 1-3
Marketing and Community Building (OPEX)				
6 person-months per Year x 2500 EUR/month (OPEX MCB1)	15,000.00	15,000.00	15,000.00	45,000.00
Other Marketing Costs: 7% of OPEX MCB1 (OPEX MCB2)	1,050.00	1,050.00	1,050.00	3,150.00
Total Marketing and Community Development	16,050.00	16,050.00	16,050.00	48,150.00

CAPEX

Further Development - Versioning

Further Development - Versioning (CAPEX)				
Software Development to catch-up with innovation and multiple VC systems: X person-months per Year x 5000 EUR/month (CAPEX DV1)	30,000.00	15,000.00	15,000.00	60,000.00
Technical and Project Management: 20% of CAPEX DV1 (CAPEX DV2)	6,000.00	3,000.00	3,000.00	12,000.00
Other Development Costs: 7% of CAPEX DV1-2 (CAPEX DV3)	2,520.00	1,260.00	1,260.00	5,040.00
Total Further Development and Versioning	38,520.00	19,260.00	19,260.00	77,040.00

Costs per Year (for 3 Years) OPEX and CAPEX

SEAL Platform	Year 1	Year 2	Year 3	Years 1-3
OPEX for 3 Years	42,262.50	51,615.00	62,347.50	156,225.00
CAPEX for 3 Years	38,520.00	19,260.00	19,260.00	77,040.00

Total Cost for 3 Years

SEAL Platform	Year 1	Year 2	Year 3	Years 1-3
SEAL Platform Maintenance - Development - Marketing Costs	80,782.50	70,875.00	81,607.50	233,265.00

OPEX per month	4,339.58
CAPEX per month	2,140.00
Total Cost per month	6,479.58

Total Cost per University

Total Cost per University	
Year 1	8,975.83
Year 2	5,062.50
Year 3	4,295.13

4.2. Benefit analysis (non-accounting terms)

SEAL is an innovative service where most potential benefits show on the mid-long term and depend on the acceptance by an important share of the stakeholders. Given the difficulty to quantify the payback of each benefit, and given that it is a fairly subjective and entity-specific task to determine the importance of each benefit for each case, we provide a generic list of identified benefits, with the goal of facilitating this personalised analysis to future adopters:

Benefits for HEI related to cost saving during the development or maintenance of identity management, based on these features:

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- Multiplatform user centric interface for managing and linking identities from several sources.
- Microservices architecture for easy extensibility.
- Packaged distribution for easy deployment and further scalability.
- Ease of integration into existing identity federations.
- Direct integration in academic/organizations web platforms or student information systems.
- Portable eMRTD eID reader.
- National eID / ePassport identity consumption.
- Verifiable Credentials derivation from other forms of identity.
- Centralisation and standardisation of the access to identity verification and linking procedures.
- Bridging between federated data providers/consumers and self-sovereign data providers/consumers.
- Provides a generic framework for the deployment of personal data management procedures.
- Function as an identity data provider for external accessing authorizations (ie. DUMA access using SEAL)
- Classical travel documents integration as sources of identity.
- Simplistic user-interface for extended usability and enhanced user-experience.
- Provides support for the registration mobility projects participants.

Benefits for HEI acting as a service provider:

- Increased security as compared to existing other forms of authentication in cross-institutional processes.

Benefits for students:

- Increased user control and privacy by using SEAL wallet.

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5. SEAL positioning

While cost-benefit analysis makes comparison of costs and benefits that can be quantified in monetary terms, in educational domain practice it is rarely realistic to value every cost and benefit of options for software maintenance or infrastructure operations in monetary terms. This is especially complex in SEAL, where the common benefit for all participant stakeholders is determined by the adherence of more entities.

There are many factors that influence sustainability of SEAL, but the positioning in the sector. We also need to address areas such as other sector business cases, technology evolution, users onboarding and service provision governance.

While the business case for adoption of identity linking and SEAL is focused on education, there are many other sectors and communities that could profit from this solution. SEAL can apply to cross-sectorial attribute exchange, reducing cost of assertions or attribute verification, use of credentials in another context, streamlining workflows or dealing with missing or erroneous data. When we consider meaningful future paths for SEAL, expansion of business cases and impact on other sectors are probably the most important factor. New business models are often the driving forces of innovation, and we also have to explore different options for SEAL.

User adoption has always been difficult in e-ID segment. Most people just want a convenient solution and they do not care about technology behind it, so, in SEAL we need to shape value proposition from this perspective, without too much use of technological terms. The user journey needs to be understood while a meaningful degree of user-acceptance also depends on awareness and training. The key issue is a sizeable number of early adopters, both students and universities as service and attribute providers, who are familiar with SEAL. This is another of the challenges for sustainability: consumers want well-established solutions that provide substantial value from the beginning. SEAL's initial value offer, despite being quite interesting due to the different offered functional components, is an emerging solution. Furthermore, besides the initial value offer, the full potential value of SEAL can only be achieved through the mutual-profit collaboration of many stakeholders and convincing them to put the required effort at no guaranteed pay-out, is a really complex task without the impulse of an overarching entity that could use its influence to put forward all the actors in a coordinated way.

Governance, policy, or infrastructure issues are other factors that go together with organizational model for support, legal contracts, rights and duties etc. Governments are the primary source of foundational identities, so called "trust anchors" that we use in SEAL bootstrapping. SEAL sustainability must look also at the establishment of policies, alignment with eIDAS growth, organizational, sectoral, and jurisdictional boundaries.

Some rules could be adopted from EBSI, ESSIF or other governance frameworks, while others have to complement these.

EBSI, for example, introduced notion of Trusted Registry, composed of EBSI on-boarding service registry (EOSR) - Organisations that are authorised to or can provide authorisation to write to the (permission) EBSI Ledger, with sub-registries that manage Trusted accreditation registry (TAR), Trusted issuers registry (TIR) and Trusted schemas registry (TSR). Trusted Issuer, for example, is a role that an entity, a person, or a thing might perform by creating a verifiable credential, so SEAL could fit this role.

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In relation to this, we also need to monitor implementation of the proposed framework for a European Digital Identity (announced by the EC in June 2021), which will implement or maybe even reuse experience gathered in European self-sovereign identity framework (eSSIF).

In addition, further investment is needed for maintaining the project results after the project end, so plans of individual partners for follow-up projects or exploitation of the results are included in Annex A: Individual Exploitation Plan - Questionnaire.

5.1. Other use cases in education domain

The main target domain for SEAL is higher education, and while the current business case is built around student mobility, we should not exclude other possible cases, for example those in professional education and life-long learning.

With changes caused by COVID-19, physical face-to-face and virtual learning, made an impact on mobility patterns, with asynchronous blended models increasingly used in education. Fragmentation, virtualization, and tokenization of proofs of achievement is another trend that has a strong impact on SEAL, while creation of European joint universities² show also policy push towards an integrated, long-term joint strategy for education that include mobility and multilateral cooperation by default.

EDSSI is the current Higher Education related project where SEAL results could contribute most with its identity linking capabilities. SEAL linked identities enriched with both eIDAS, travel document and academic attributes can be easily integrated in the EDSSI authentication proxy, thanks to its ability to act as a standard eduGAIN SAML2 Identity Provider (IdP).

One of the possible use cases would be to publish SEAL SAML2 IdP interface on the metadata in a EduGAIN federation, so all EduGAIN SPs can act as consumers for SEAL data. Adding the SEAL IdP into eduGAIN could greatly benefit Higher Education institutions for processes like secure enrolment of foreign students.

The great achievements SEAL has done in integrating with UPort SSI environment can also offer an already working solution for linking Self Sovereign Identities easy to integrate on the EBSI infrastructure. This would be the European Student Data Service Infrastructure.

Since 2020, EBSI is deploying peer to peer interconnected, distributed blockchain nodes across Europe, driven by the public sector. The latest EBSI v2.0.0 APIs are now in the pre-production environment. Besides improvements of users onboarding there are other advances with the latest APIs and test scripts aiming at satisfying requirements of the first wave of Early Adopters (e.g. onboarding procedure to the Trusted Issuers Registry (TIR) and Trusted Schema Registry (TSR)).

While the initial set of EBSI use cases already contained diplomas verification, that is directly relevant to SEAL, in 2021 EBSI will be enriched by other use cases. In addition, EBSI will be open to private companies and organisations with new opportunities to support the implementation and integration of the use cases that make use of SEAL services.

So called “Wave 2” aiming at broadening the uptake and move to a real-life production context of EBSI, launched so called EBSI Early Adopters (EA) Programme. SEAL partners are in the close contact with EBSI EA convenors and will explore this path as well.

² https://ec.europa.eu/programmes/erasmus-plus/programme-guide/part-b/three-key-actions/key-action-2/european-universities_en

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These capabilities together allow for easier set up of cross-HEI services thus supporting the newly created European University alliances. For example, the European Reform University alliance has already decided on using SEAL services for their authentication and identification needs.

Identification of target audience segments in higher education, value proposition, channels, cost structure and potential business models should reuse findings from the evolution of identity ecosystems that are already there. Said this, during the project execution SEAL partners have already been in constant contact with several initiatives and projects.

As it was already described, QualiChain targets the creation, piloting, and evaluation of a decentralised platform for storing, sharing and verifying education and employment qualifications. However, unlike SEAL, it also interfaces with private education, the labour market, public sector administrative procedures and the wider socioeconomic developments.

Universities issue diplomas for students, that sometimes can be downloaded as PDF for printing and present where paper is accepted, thus eliminating the electronic protections and making it easy for a student to alter the diploma. Fake diplomas are truly big problem today, not only for universities reputation, but also for the labour market. An automatic check of diplomas, or parts of it (e.g., subjects), as verified credentials, could address this problem together with a requirement for documents to be presented electronically.

During the project lifetime, SEAL already collaborated with QualiChain project to develop use cases and test applicability in a wider context. The following cases have been developed and documented:

- Entering the QualiChain network is a use case similar to SEAL regarding issuing credentials from an organisation perspective. It targets an undergraduate student that wants to choose courses and extracurricular activities and will help him/her follow a certain career path.
- Professor use case tackles the situation when a professor wants to enter the QualiChain platform to award smart badges to his students and update his courses.
- Recruiter use case showcases the job agency that wants to enter the QualiChain platform to create a new job post and search for suitable candidates.

Blended learning is used not only in higher education, but also in corporate training, for example in security with many hands-on exercises where cyber-ranges, as well as physical mitigations can take place. Companies can invite foreign company experts to deliver professional talks for their employees without requiring them to do a physical visit. Also, an employee may choose to have a synchronous lesson in the physical classroom or cyber classroom and interact with other employees regardless of their location. Verified credentials would be very useful, not only as a replacement for professional certificates, but also to track achievements.

5.2.Possible solutions for other domains

If we look at the expansion of use cases outside education sector, user should be able, in principle, to link “trusted anchor” identity to any attribute from any other domain and create integrated “verified credential” based identities that are required by the service provider.

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One obvious business case is public sector. Swiss municipalities have been working on their own e-identity means linked to a blockchain at the local level. The city of Zug has been offering solution since fall 2017 using Zug ID³ (based on uPort from Consensys) which is supported by Ethereum blockchain infrastructure. The ID data is stored here in what they call “digital locker” of the user’s app. For verification, however, the user of the Zug ID must be personally present in the townhouse once. In a similar manner, the canton of Schaffhausen⁴ already piloted the e-ID solution called Schaffhauser eID+ with technology from ProCivis, which is blockchain-based as well.

Another case are different scenarios related to mobile Driving Licenses (mDLs) and identity linking service to selected subsets of the identity related data available in an mDL (e.g., category of vehicle for which owner has licence). Similarly, holders of mDLs, but also rent a car companies, will appreciate the convenience of having a standard identity linking and verified credential that can be used in many contexts, but also offers assurances that their privacy will be protected and that their identity will be secure.

Know Your Customer (KYC) mechanisms is an important piece of identity verification that is currently growing, and many public sector bodies are in need of these services. Actually, some countries are already setting up some kind of KYC schema. SEAL has provisions for incorporating KYC mechanisms in an interoperable way that would benefit from the eIDAS electronic identity.

For financial services organizations digital onboarding is costly process, prone to errors and fraud, and it can also create poor customer’s experience. In addition, there is also regulatory burden, and in particular, anti-money laundering (AML) and counter terrorism financing (CTF) requirements. In this context, so called Know Your Customer (KYC) use cases are important opportunity for SEAL and its brand “MyIDs”. It could provide additional confidence in customers’ identities and identity linking which is difficult and time-consuming to achieve manually.

This KYC service could be provided to financial or insurance companies, but also others, such as gambling providers to facilitate their customer identification processes. There would be needed to connect to financial company identity store and to share attributes from a bank or tax account, while SEAL identity verification modules would take care of identity document proofing and validation. The advantage of using SEAL is that unlike many other KYC solutions, it is asynchronous and does not require a live video meeting or biometric verification. This improves the end user experience and is reducing the sense of intrusiveness, while shortening the time required for completing the process. In a matter of fact, Signicat research⁵ shows that 40% of consumers abandon a banking onboarding process, mainly as a result of the time needed to complete the onboarding process or the need to provide too much personal information.

In general, using a trusted government issued eID greatly simplifies onboarding processes and even basic information data capture. This has been proven with one of the SEAL demonstration university applications: the UMA invitation system.

There are other examples in diverse sector that would benefit from privacy preserving user centric linked identities, like the ones proposed by SEAL:

- COVID green certificates

³ <https://consensys.net/blockchain-use-cases/government-and-the-public-sector/zug/>

⁴ <https://sh.ch/CMS/Webseite/Kanton-Schaffhausen/Beh-rde/Services/Schaffhauser-eID--2077281-DE.html>

⁵ Signicat Innopay Report: The Rise of Digital Identities, Plugging the ‘digital gap’ in financial services onboarding

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- eID linked boarding passes
- Events access tickets
- Loyalty cards
- Disabled parking permits
- Pharmacy e-prescriptions
- Hotel pre-check-in police Kardex registration

All previous examples can reveal only the attributes required for authorising the transaction occurring with the person physically present, without the need to reveal extra information or documents, even the identity, but keeping a traceable link to the real identity backed by the government issued eID.

For the sustainability it is important also to develop modules that reduce burden of the connection to the new source of identity attributes, and to indirectly support establishing trusted links between the datasets to be transferred between institutions.

Most commercial identity providers have built their solutions on OpenID Connect because of its strong support for mobile platforms and ease of integration. To leverage on “legacy” identities, these also need to be considered for linking. Several Identity Providers already provide access to government issued identities via OpenID Connect, so we should also investigate impact on sustainability related to sets of attributes maintained according to different trust frameworks and at different trust levels.

5.2.1. Cross-domain ecosystems

The word ecosystem in itself is frequently misused and in our context, we refer to “a distributed, adaptive, open socio-technical system with properties of self-organisation, scalability and sustainability”. In US, National Strategy for Trusted Identities in Cyberspace, define Identity Ecosystem as a user-centric online environment which is a set of technologies, policies and agreed upon standards that securely supports transactions ranging from anonymous to fully authenticated and from low to high value.

SEAL is assuming that there will be several eID ecosystems in Europe, such as public sector, ICAO/IATA ePassport ecosystem, education ecosystem around eduroam, healthcare, eCommerce, and others. There is also an opportunity to be positioned at the crossroads of these ecosystem. SEAL is linked to a subset of eIDAS ecosystem, while also relying on elements of other ecosystem for identity linking. Belgium, Spain, Germany, Hungary, Latvia, Lithuania, Malta, Luxembourg and Slovakia have smartcard based eID in use, while many other countries have it in development phase, so we expect this ecosystem to grow rapidly, also due to the recent proposal for a regulation on strengthening the security of identity cards of European Union citizens and of residence documents issued to European Union citizens and their family members exercising their right of free movement.

The SEAL sustainability plan is built on top of the vision that different eID ecosystem tendencies can be addressed in parallel. While user-centric and internet-scale eID schemes (e.g., existing SSI schemes) need to elevate their level of assurance and become more resilient to cyberthreats, strong security eID schemes can also be adapted for certain range of application where the usability or user-control, with the help of verified credentials and identity linking, is the key to wider adoption and use.

We also witness strong demand for separated service of identity proofing and verification (IPV), detached from the other phases of e-ID lifecycle (e.g., issuance, authentication, management), mainly motivated by specific business cases (e.g., digital onboarding, know your customer). eIDAS legal

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framework enabled specialized service providers to act also as remote (in this context meaning “located in another EU member state”) identity verification providers. SEAL can take advantage of this trend, and maybe act as key stakeholder for education sector and promote establishing a coordinated framework for identity and IPV management in a collaborative environment.

5.3. Opportunities and threats

Threat and opportunities are quite a continuum in a field like eID with technologies that, although in extended use in some domains, are not yet widely in use in the general population and even less understood by final users that have been trained to extenuation in username-password combinations.

On June 3rd, 2021, the Commission proposed a new framework for a European Digital Identity which would include new Regulation, that will support link of national digital identities with proof of other personal attributes (e.g., driving licence, diplomas, bank account). It has been stated that these wallets may be provided by public authorities or by private entities, provided they are recognised by a Member State.

The Commission communication also mentions a common toolbox by September 2022 in order for the MS to start the necessary preparatory work immediately. This toolbox should include the technical architecture, standards and guidelines for best practices.

This could be a great opportunity for SEAL, as the alignment with the toolbox and the upcoming framework is likely to be easier than for the competing solutions.

One of the key issues for the sustainability of SEAL is trust management and especially rapid verifiability when boundaries between trust domains change continuously. SEAL users start with an empty digital SSI wallet. We expect in the future there will be some interoperability or a standardized self-sovereign digital wallet, able to accept connections to/from other providers or other means of bootstrapping.

When VC are offered and accepted by users, the control and responsibility of sharing of a subset of data from a VC, or just proof that user has VC, is for the user. Unrelated trust domains now have a link, without requiring direct connections to one another.

Verifiable Credentials are unique identities that serve as the role of the root of trust, this means that they are verifiable and trusty, and further credential issuance can be done on top of them. Considering a non-common digital signature mechanism named DID Signature is used in their generation, the VC meta-issuer integrates the main service signature on the credential allowing extensibility and continuation of the chain of trust.

This presents the main feature of the Verifiable credentials, but at the same time exposes a very interesting theoretical problem. At this very moment, the SEAL service uses eduGAIN and eIDAS as its main identity providers, but new horizons are foreseeing as European EUID is planned to be included. Indeed, the matter lies on how to maintain the root of trust while relying on external identity providers in the gathering of personal information, and how to do that while widening the list out.

From the analysis of this question, we can extract several assumptions and concerns, for instance, it is very important to thoroughly define the structure of the end service to which the SEAL VC Issuer will be oriented, and in case it is a high liability environment, take the precautions accordingly.

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As it has been designed, the use of central storing repositories has been avoided, as it will undermine the whole user-centric characteristic of the system, but in some cases where these characteristics are essential, a new central agent could be integrated, serving as a transaction broker and ensuring the trackability of misbehaviours without compromising the securely transacted information.

This has not been the approach taken by SEAL, instead, the service lightens up on this by making the user in full control of the identity data. While doing this, also the service providers themselves could take benefits out, by having the liberty to ask for expected attributes to allow the user to access their services. In this paradigm is the user the one who utterly control what attributes are given, and what are not, and as a result of that, the service provider could eventually allow access or notify the insufficient attributes received.

Even with that in mind, the integration with high liability and accountability environments needs further research, although this could be potentially taken as a first step for the next revision of the eIDAS framework, using all this gathered information for improving the future integration of wallets, attributes services as Trust Services Providers (TSP), among other innovations.

As a designed feature, the SEAL service and therefore the SSI VC Issuer relies on the core trustiness of the service providers, however, this analysis has also enlightened that Verifiable Credentials shall not be issued only taking into consideration the service-end usability.

A good precaution for improving this chain of trust is to previously provide users with credentials, this way the ‘issuance on the go’ could be restricted and hence, empowering the root of trust that lies under this former user VC.

One opportunity lies in a increasing need, in all sectors, to use trusted identifiers from government issued identification card (eID card) or e-Passport, for identity verification and proofing, as well as to rely legally on eIDAS Regulation that includes provisions which are binding for all EU member states and that include concept of “notified eID”. In this direction, there is also a weakness related to the implementation and adoption of eIDAS infrastructure, as only one third of the eID schemes have been notified under the eIDAS regulation. Similarly, there are uncertainties related to on-going block chain projects, aiming to increase connectivity and transparency of the built solutions.

Cost avoidance is one of the main drivers for service providers, as they need to connect to infrastructure, such as eIDAS or adopt their own solutions for identity management. The same holds for the use of identity services, such as a verification, whether these are provided online or off-line. For example, onboarding costs for businesses with KYC Processes is about 15 euros, and in some cases, already onboarded users are required to go through the same or similar processes in order to have access to different services or products. Although some identity verification solution reduce this cost, use of SEAL would drive this price down even further.

There have been some SSI projects trying to address separated issues in identity lifecycle management, such as Civic, WalliD, Uport, Persona, Kriptan, SelfKey, TRC and others. All of them solve some related to identity protection, identity sovereignty and identity data immutability, but they did not build trust networks that verify that the data uploaded to the blockchain is in fact from the citizen who uploaded it. In other words, the challenge is to bring the already existing chain of trust produced by member states issued identity documents with eIDAS infrastructure and regulation that supports pan European adoption.

Some projects tackle that problem by bringing identity validators trusted by their community into the protocols, or by relying in a centralized but public network of validators. A shared infrastructure for

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businesses, governments and individuals also needs governance rules, operational standards, and a guarantee for the long-term viability. The move from attribute exchange network (AXN) and verification network (VN) is needed towards identity linking network (ILN) or ecosystem, and this could be an opportunity for SEAL, which provides a mechanism to reuse and export the links across different consumers and domains, effectively reducing costs and efforts for all the actor implied in this process. This can effectively drive the collaboration to build public-sector verification networks and reduce dependence on the expensive private-sector client-specific isolated solutions.

At the crossroad of these business cases, technological pillars, user adoption trends and governance developments, we identified several differentiation points, used as “catalysts”, each one addressing specific aspects. These have been monitored during the project execution and will form basis for the SEAL opportunity in the future.

Multi-sided networks, such as eID scheme, where user adoption depends on number of services offered, and other way round, is very specific and has so called “network effect”. We need to match demand with supply, in other words, the probability that the SEAL identity linking has the access to attributed and verified identity for the user that a relying party (also called service providers) needs and can consume. While this holds for any domain, in every market sector and for every identity attribute, education presents some specificities, for example pre-existence of other eID schemes and trust relationships, so there is a threat that the expansion to the other markets is not so easy. In this sense, SEAL is still in its early stage of adoption, which could be a drawback. SEAL, despite its used of widely deployed and used technologies, is a newcomer in identity services, thus the current (low) level of use could be a threat to its acceptance.

We can envisage many other business cases in different domains, for example, bank that needs a specific credit score attribute that only other attribute providers can provide. Therefore, a strategic partnership or incentive scheme is needed to engage with them.

Once they have vested interest in the success of the SEAL ecosystem, they will encourage other businesses in their network to join. As we hit a critical mass of attribute providers and verified identities, there are further possibilities, for example provision of enablers for more service providers, better tooling, and more developers. Again, this threat is related to achieving critical mass of users.

There are possible stakeholder rejection challenges, for example that users may not adopt the system due to poor design or distrust. SEAL needs to address this through involvement of trusted partners. Some of them might perceive SEAL solution as a limited scope and scale, and potentially valueless, and therefore not adopt it, but if there is sufficient support SEAL could experience sustainable and continuous uptake. Large and complex plans should be avoided.

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6. Action plan for future proofing SEAL

6.1. Individual partners plan

As it was pointed out in section 5. SEAL positioning, further investment is needed for maintaining the project results after the project end. All partners have presented their individual plans for follow-up projects or exploitation of the results, which are included in Annex A, and based on these statements we can also draw a realistic action plan for the future uptake and growth of SEAL community and services. Questions of this plans are listed below, and the roadmap answers (question 8) are summarised in this section.

Individual partners plan questions:

1. Partner profile
2. Motivation to participate in the project and commitment
3. Means to achieve your objectives
4. Opportunity which appeared/appears
5. Exploitable assets and results
6. Rationale
7. Your Value Proposition towards Joint Exploitation of SEAL
8. Roadmap: the timeline plan you have for using those assets
9. Measurement
10. Numbers

Universities will gradually integrate SEAL solutions during the next academic term (2021-2022). UAegean is committed to the sustainability of the SEAL Platform and to the investment of the necessary resources to face ongoing challenges such as interconnection with the emerging EBSI infrastructure and the inclusion of the European Student Identifier in the elements of a Linked Identity. About dissemination activities, University of Porto during the next years, will keep pushing the Top-Level management towards integrating SEAL usage into any University of Porto portal that needs external data, specially retrieve from EWP or similar networks. Jaume I University plans to disseminate SEAL results in all available events. EUNIS and local NREN biyearly meetings will be the main and most sure targets. Other possible targets for UJI are the conference of rectors and Terena meetings, through the NREN collaboration. University of Málaga will start dissemination efforts in the fall of 2021 with the Groningen Declaration annual conference in Toronto and, maybe present at the ARSEE annual conference or PESC fall data summit. UAegean, will promote SEAL as the core authentication/identification tool within the European Reform University Alliance⁶. SEAL may support an one-stop authentication scheme with the use of a Digital Verifiable Credential allowing access to online services that will be part of the digital space ERUA partners (UAegean, Univeritat Konstanz, Univ. Paris 8, Roskilde University and New Bulgarian University) will create in common and share to host ERUA project activities.

GRNET will continue working with the key partners of the project, and they intend to integrate some components as part of other eID solutions. Regarding eduGAIN and eIDAS proxies, GRNET will

⁶ <https://erua-eui.eu/>

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continue to serve SEAL and the respective deployment will remain for two years after the termination of the project.

The Ministry will continue working closely with GRNET and the General Secretariat of Information Systems for the Public Administration. Moreover, since it is part of the approval process for national participation in CEF funded Telecom proposals, the Ministry will detect a potential network of synergies regarding digital identities. About dissemination activities, the Ministry will try to disseminate the project through the National Coalition for Digital Skills.

Atos, will present SEAL results to IDnomic, company acquired by Atos and now part of Atos BDS division, (Q3-Q4 2021) to discuss remote digital onboarding, so possible convergence and transfer could be explored. In addition, project presentation to some clients outside of educational domain (e.g. Caixabank for KYC process) is also scheduled.

6.2. Roadmap

The future of SEAL relies on institutional backing and stakeholder adoption. On one side, we need backing from reference sector organisms interested in our value proposal, but at the same time this backing needs to go hand in hand with the adoption by a critical mass of service providers and students. The first and foremost task leading to SEAL adoption must be raising awareness about the quality and value proposition of our results. Getting the stakeholder to know SEAL and understand the underlying identity reconciliation issue, is the key for success. Any organisation trying to improve or transform their online procedures to involve multiple parties could be our target audience. This could be placed in the scope of a larger framework, such as student mobility in educational domain, or digital transformation in the other sectors, with a clear communication how SEAL proposes to face issue of identity management across distributed identity attribute silos. SEAL can be understood only as a part of a larger solution that allows bridging different domains, institutions and actors, across identity ecosystems, including also previously separated realms and paradigms, such as government issued cards and passports, federated identity and the self-sovereign identity. This initial wave of raising awareness activities, should later trigger expert discussions and a raise of interest, leading to institutions and stakeholder on-boarding, further propagation of references, and finally involvement of the key sectoral organisations and governance actors, thus achieving the required backing.

This process will generate a series of contacts and requirements from the organisations interested in adoption, which will serve to increment and support SEAL community, and will be contacted by the SEAL partners as expert service providers for those needs, either for free or as paid service offering. However, this will depend on the nature of the service, the plan and resources of the partner, and the status of the adoption, because in the first phase, the most support and help we offer will be for free, in order to drive fast adoption.

While we might use term “SEAL service” to denominate identity management related services, such as linking, we also use the word service to denote a wide range of additional (human support) services offered by the SEAL consortium partners. Some of these services are almost obligatory (e.g., configuration) and some will be recommended (e.g., deployment support). The services could be included in the “adoption package” either for free or with the fee, while the other services that are considered optional (consulting or system integration) should be provided upon the payment of a service fee. In the case of a complex integration with customer legacy systems, the whole offering comes to

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resemble tailor made solution (although with lower cost due to reuse of SEAL components). After internal prioritization by consortium partners, list of these services has been decided and is summarised in the table below in order to set up priority and decide whether these need to be subsequently addressed in detail.

Expert Services	eID Profiling Workshops Assessments & Maturity Checks Strategy consulting Policy design and solution plan assessment Design and Modelling Use case consulting Audit and compliance checking End user training
Managed Services	Managed User Helpdesk Managed Security Monitoring Remote Mitigation Service User Administration Data Lifecycle Management
Integration & Maintenance Services	Software Installation and Integration Configuration and customisation support Remote evolutive maintenance Corrective maintenance

The final offering and roadmap could be personalised for each customer. This would become one of the main guidelines for the design of SEAL and MyIDs adoption, since all types of target audiences are considered as potential customers. Self-service is also envisaged for smaller institutions that have a limited budget for cybersecurity solutions and for training, but as the adoption and use of SEAL results (e.g. through MyAcademicID or EDSSI) grows, the focus is shifted towards more demanding user needs, and the importance of these added value services became more prominent.

When it comes to EDSSI, we should mention that several SEAL partners are participating in this project and there are already actions planned to introduce SEAL results to the rest of partners that could contribute or use its identity linking capabilities. In this direction, the main message to be conveyed is that SEAL services can be easily integrated in the EDSSI authentication proxy, thanks to its ability to act as a standard eduGAIN SAML2 Identity Provider (IdP). As it was already mentioned, one of the possible use cases would be to publish SEAL SAML2 IdP interface on the metadata in a EduGAIN federation, so all EduGAIN SPs can act as consumers for SEAL data. Adding the SEAL IdP into eduGAIN could greatly benefit Higher Education institutions for processes like secure enrolment of foreign students.

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As for the other Expert Services provided by the partners that are considered to be exploitable and delivered after the project ends, these include diverse consulting or training types of activities. We give several examples below:

- eID Profiling Workshops: It is a service helping clients to define their landscape in terms of existing identity attributes, registries, consumption of eID, etc. It also includes assessment of ambitions, cross-border priorities and attitude including IT/business alignment. It involves strategic guidance and consultancy on understanding, embracing and adopting the risk-driven approach to eID transition and migration to a new system.
- Assessment & Maturity Checks: experts can also perform cybersecurity maturity or readiness assessment, whether as an activity previous to the customisation of integrated solution or as a service combined with the other services, such as consulting.
- Design and Modelling: The aim of this service is the design of an objective and optimised design tailored to the customer. It involves consultancy and guidance at every step of the eID linking solution.

The Managed Services are offered to the customers that either do not have technical capacity at all or are in the process of reduction capital expenditure (CAPEX) and want to move to cloud-based model. It could be provided by project partners, by a larger university or by an association, such as NREN in the case of smaller HEI.

Although many improvements of SEAL open- source software will be done through community, we also envisage use of the paid integration and maintenance services, especially for case-specific modules to connect data sources, data providers, IVP providers or SSI environments, that are typical technical services that can be done by any system integration company. The customer can contract these in order to save time, for example when evolutive or corrective maintenance is not provided by the community or cost, in the case software installation and deployment support is needed.

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Conclusions

SEAL project results offer a powerful way forward in the eID space that offers an opportunity to change the old paradigm of separated identity and attribute providers.

The ability to link identities from diverse sources, including high level of assurance sources that rely on physical support like ePassports or eID cards, and many legacy sources of identity attributes, such as student information systems, is an important value proposition. Many opportunities exist, starting from transformation for later use and consumption of credentials, adapted to different consumer methods and protocols, and is an excellent tool to also build bridges between current deployed technologies, like SAML identity federations, into future ones, like Verified Credential.

SEAL, thus, builds bridges. Between federations. Between trusted identity providers and service providers. Between identity verifiers and consumers. This opens a vast field of possibilities for real interoperability for online services, usually limited to simple interactions involving few concurrent parties.

SEAL proposes a common ruleset for interaction, and a mechanism to reuse and export the links between entities and datasets across different consumers and domains, effectively reducing costs and efforts for all the actor implied in this identity verification process.

The main challenge here is to onboard all the relevant stakeholders on the discussion and improvement of this proposal, with the goal of promoting it to achieve a critical mass of user institutions. The same way SSI paradigm has opened its own path transversally at all levels of public administration, educational institutions and private sector companies, SEAL has identified the overarching need for managing the reconciliation of identities in a portable, flexible and standard way, and has the aim of opening its own path.

To achieve it, one of the first steps is to bring the already existing chain of trust produced by member states issued identity documents, through the common-benefit motivations and collaboration of the eIDAS regulation. SEAL becomes a central actor a technical level to help overcome this step. Through the adoption of SEAL at key levels of the academic domain, interest would be on the rise, and would bootstrap the adherence of HEIs to use the SEAL services for identity, running under the trust of these reference institutions on the domain.

On a second phase, appears the need to onboard KYC and IVP providers. A market currently dominated by private companies, and with public initiatives limited to government isolated systems for their own management, SEAL ambitions turning this scenario onto a new one of collaboration and interoperability of IVP. With support and guidance from these key reference entities, strong trust and identity validation networks can be created to support the effective pan-European interoperability on reconciliation of identities, and thus reduce dependency on the expensive private-sector client-specific isolated solutions as new digital services demand more trusted data and links.

As much as the scenarios depicted above look enticing, they are not easy to achieve in wide scale, because there is an important drive in many diverse fields ranging from policy to technical deployment, as well as general population education about eID concepts in general and ways of using it in general. Through experience, and along the technical discussion with the key stakeholders, user-friendliness should be improved, and mechanisms to close the knowledge gap in the end user should be envisaged.

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The user centricity of SEAL developed interfaces, like the dashboard, are step in the right direction, in complete alignment with the requirements of GDPR, but all surrounding technologies from eIDAS to VC wallets need also to walk in the user-friendliness direction, which will be achieved with the achieved running experience and with the synergies built through discussion with sector experts.

If we all, as a community, can work together using the building blocks of SEAL and other sister project results, there is a great opportunity to do eID right this time.

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Annex A: Individual Exploitation Plan - Questionnaire

Individual Exploitation Plan of ATOS

	QUESTIONS
PROFILE AND MOTIVATION	<p>1. Partner profile: brief introduction about your organization, explaining your background (technical or business) and what is your field of operation.</p> <p><i>Atos is a global leader in digital transformation with approximately 110,000 employees in 72 countries and annual revenue of around € 12 billion. The Group provides many IT services, solutions, as well as transactional services. With its cutting-edge technologies, digital expertise and industry knowledge, Atos supports the digital transformation of its clients across various business sectors, including education.</i></p>
	<p>2. Your motivation to participate in the project and commitment: why did you join consortium and your role in the project.</p> <p><i>Atos is one of the industry leaders in trusted digital identities solutions and there is a continuous need to stay up to date with the latest technological advances, such as the use of verified credentials and identity linking services. Atos has been working in many previous EU projects and has ownership of software needed to establish a trusted environment for identity proofing and verification, but it needed partnership with universities to be able to make and test a complete solution. In this sense, education domain and SEAL project are ideal project to generate and manage credentials, while meeting the highest criteria when it comes to security, quality and robustness.</i></p>
	<p>3. Means to achieve your objectives: show that you have necessary background (resources, dedicated department or working group, infrastructure).</p> <p><i>Atos Research & Innovation (ARI) is the R&D hub for emerging technologies and a key reference for the whole Atos group. We have multidisciplinary and multicultural team with the skills to cover all the activities needed to run projects successfully, exploit know-how and software from SEAL and commercialize similar project in the other domains.</i></p>

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	<p>4. Opportunity which appeared/appears: your participation is the result of the real need of your customers (with whom did you speak, which client asks you to provide it, all existing/potential requests, etc.). For academic partner mention if SEAL is in line with other projects (continuation). If there are other opportunities in the pipeline when project finished?</p> <p><i>Recently EC proposed a new framework for a European Digital Identity that includes Digital Identity wallets on citizens phone, which is approach very similar to SEAL. We believe there will be many opportunities related to online services access with these new means of identification, which will be linked to national eld cards and/or ePassports, just like in SEAL and will be recognised throughout Europe. EC also claims that large platforms will be required to accept the use of European Digital Identity wallets upon request of the user, which is also a difference in respect to uptake of eIDAS framework. We have also contacted some of our clients that work on KYC process and presented them initial results (e.g. Caixabank in the finance sector), and in the future we plan to intensify these type of actions.</i></p>
WHAT AND WHY	<p>5. Exploitable assets and results: Describe what assets (whether this involves specific components, tools, knowledge, methodologies, skills, etc.)</p> <p><i>All SEAL assets are released under the open source license but can distinguish those that have been developed by Atos (where we have IP and in-depth coding know-how), and other where we have more integration-related know-how.</i></p> <p><i>Asset with IP ownership: assets are wrapper for eMRTD reader (based on Apache 2.0), API gateway (EUPL), derivation module (EUPL). All these will be uploaded on github and maintained by SEAL community, where Atos will be also involved.</i></p> <p><i>Request manager (EUPL), configuration manager (EUPL), and eduGAIN module are based on the pre-existing software from ESMO but have been adapted to SEAL by ATOS.</i></p> <p><i>As for those assets that are open source but not owned by Atos, we consider to use OIDC interface (federated validation interface) in the other projects.</i></p>
	<p>6. Rationale: Explanation of why are you interested on those assets (the added-value they provide), how do you plan to exploit them (academically or industrially: e.g. provide as commercial solution, certification services, standardization, consultancy, further R&D, Brand positioning)</p> <p><i>Even all assets from SEAL are released as open source, we are sure that our know-how related to its integration, deployment, configuration or further maintenance gives us competitive advantage.</i></p> <p>7. Your Value Proposition towards Joint Exploitation of SEAL: what do you propose to project, what benefits will be delivered to customer, end users, what components/interest do you share with other partners.</p>

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	<p>Atos is a service company and we offer consulting, support, managed operation and maintenance services for the SEAL (or its follow up which is branded MyIDs) operators. They will save money and time by reusing our services based on achieved know-how. This also applies to any SSI alignment with EU digital identity framework and related projects.</p>
<p>ROADMAP WITH TIMELINE</p>	<p>8. Roadmap: the timeline plan you have for using those assets: (what, where, to who, e.g. meeting with board to present them, inclusion in your portfolio in 1 year, etc.). Provide concrete actions</p> <p><i>Presentation to IDnomic, company acquired by Atos and now part of Atos BDS division, (Q3-Q4 2021) to discuss remote digital onboarding, so possible convergence and transfer could be explored.</i></p>
	<p>9. Measurement: how do you plan to measure impact of planned actions (some KPIs defined and criteria for success to reach)</p> <p><i>Inclusion in Atos portfolio in 2022</i></p>
	<p>10. Numbers: if you can provide any figures as a reference point to show what is above, would be more than appreciated</p> <p><i>It is qualitative KPI</i></p>

- Others, all not covered with questions above, but relevant for SEAL partner.

Individual Exploitation Plan of UAegean

QUESTIONS	
<p>PROFILE AND MOTIVATION</p>	<p>1. Partner profile: brief introduction about your organization, explaining your background (technical or business) and what is your field of operation.</p> <p><i>UAegean is one of the most active and productive Universities in Greece in terms of Applied Research and Innovation.</i> <i>The Engineering School of the University has a clear focus on the design and development of ICT technologies and services and, in broader context, on digital transformation strategies (digital tools and capacity building) for the government and the industry. Times Higher Education World University Rankings 2019.....</i></p>
	<p>2. Your motivation to participate in the project and commitment: why did you join consortium and your role in the project.</p> <p>.....</p> <p>.....</p>

	<p>3. Means to achieve your objectives: show that you have necessary background (resources, dedicated department or working group, infrastructure). </p>
WHAT AND WHY	<p>4. Opportunity which appeared/appears: your participation is the result of the real need of your customers (with whom did you speak, which client asks you to provide it, all existing/potential requests, etc.). For academic partner mention if SEAL is in line with other projects (continuation). If there are other opportunities in the pipeline when project finished? </p> <p>5. Exploitable assets and results: Describe what assets (whether this involves specific components, tools, knowledge, methodologies, skills, etc.) </p> <p>6. Rationale: Explanation of why are you interested on those assets (the added-value they provide), how do you plan to exploit them (academically or industrially: e.g. provide as commercial solution, certification services, standardization, consultancy, further R&D, Brand positioning) </p> <p>7. Your Value Proposition towards Joint Exploitation of SEAL: what do you propose to project, what benefits will be delivered to customer, end users, what components/interest do you share with other partners.</p>
ROADMAP WITH TIMELINE	<p>8. Roadmap: the timeline plan you have for using those assets: (what, where, to who, e.g. meeting with board to present them, inclusion in your portfolio in 1 year, etc.). Provide concrete actions</p> <p><i>UAegean is committed to the sustainability of the SEAL Platform and to the investment of the necessary resources to face ongoing challenges such as interconnection with the emerging EBSI infrastructure and the inclusion of the European Student Identifier in the elements of a Linked Identity. UAegean will promote SEAL as the core authentication/identification tool within the European Reform University Alliance . SEAL may support an one-stop authentication scheme with the use of a Digital Verifiable Credential allowing access to online services that will be part of the digital space ERUA partners (UAegean, Univeritat Konstanz, Univ. Paris 8, Roskilde University and New Bulgarian University) will create in common and share to host ERUA project activities....</i></p> <p>9. Measurement: how do you plan to measure impact of planned actions (some KPIs defined and criteria for success to reach) </p>

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	<p>10. Numbers: if you can provide any figures as a reference point to show what is above, would be more than appreciated</p> <p>.....</p> <p>.....</p>
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- Others, all not covered with questions above, but relevant for SEAL partner.

Individual Exploitation Plan of Universitat Jaume I (UJI)

	QUESTIONS
PROFILE AND MOTIVATION	<p>1. Partner profile: brief introduction about your organization, explaining your background (technical or business) and what is your field of operation.</p> <p><i>General studies university, with innovative technical programmes. One of the pioneering universities in Spain on the Internet access and applications. The central innovation and IT audit office has long had an outstanding interest and involvement in identity management projects and scene.</i></p>
	<p>2. Your motivation to participate in the project and commitment: why did you join consortium and your role in the project.</p> <p><i>UJI is the technical coordinator of the project, and main promoter of the concept idea behind it. Interest on bringing the concept to life appears from the longstanding observation of limitations and needs in eID related use cases.</i></p>
	<p>3. Means to achieve your objectives: show that you have necessary background (resources, dedicated department or working group, infrastructure).</p> <p><i>UJI innovation and IT audit office has a strong and talented employee roll. The personnel devotes its time to prospective and strategic aspects of the university governance, with the IT audit and innovation team, formed by 4 people, being the closest to the head office. The office has also close collaboration with the central analysis and IT development unit, composed of 15 analysts, which participates on the project providing support for the software analysis, development, and integration tasks. The long list of eID related projects, starting with STORK, are the starting ground for the concept of SEAL.</i></p>
	<p>4. Opportunity which appeared/appears: your participation is the result of the real need of your customers (with whom did you speak, which client asks you to provide it, all existing/potential requests, etc.). For academic partner mention if SEAL is in line with other projects (continuation). If there are other opportunities in the pipeline when project finished?</p> <p><i>SEAL appears as an attempt to design a general solution for the observed issues with user account management, account duplicity, etc. This perception grows even bigger</i></p>

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	<p>after experiencing this issues in federated services during STORK 2.0 project, and on the NREN federation. SEAL evolves as a new concept, but closely related through its final goals with the problems being solved on the ESMO project. Being so general, SEAL has many diffuse ways of evolution, but the most promising one follows the direction of other self-sovereign identity projects.</p>
<p>WHAT AND WHY</p>	<p>5. Exploitable assets and results: Describe what assets (whether this involves specific components, tools, knowledge, methodologies, skills, etc.)</p> <p><i>The most immediately exploitable assets from SEAL are the VC issuer and verifier, and the automated linking engine, being ready to go software components that can fit in other initiatives to solve immediate issues. But the most important asset of SEAL is the proposed conceptual framework for link management, which need debate and refining with the ambition to become a standard solution for a still diffuse problem. The SEAL service, as such has a potential for adoption and evolution, but achieving that will require much more compromise from the stakeholders, besides the initial after-project backing from the consortium.</i></p>
	<p>6. Rationale: Explanation of why are you interested on those assets (the added-value they provide), how do you plan to exploit them (academically or industrially: e.g. provide as commercial solution, certification services, standardization, consultancy, further R&D, Brand positioning)</p> <p><i>Besides the usage on the currently integrated services, there is an interest in deploying the linking engine internally for other procedures, and to study the chances of VC issuer and VC verifier integration. The main exploitation plan is related to the dissemination in the academic forums of the linking conceptual framework, and to promote the establishment of collaborative public-sector identity proofing and verification mechanisms according to this framework and connected to SEAL service</i></p>
	<p>7. Your Value Proposition towards Joint Exploitation of SEAL: what do you propose to project, what benefits will be delivered to customer, end users, what components/interest do you share with other partners.</p> <p><i>The value of the joint exploitation depends on the adoption. And the adoption depends on the perceived benefits. SEAL offers access to consumers through already existing federated interfaces, so integration effort would be low. The decision would lie then on whether they can visualise the usage of links on their management processes where identity proofing is required. The good point is that since most institutions are available through EduGAIN, adoption for consumer does not depend on the adoption of others. The key to achieve a raise on interest would be attracting identity proofing providers to integrate with SEAL, being the main barrier that they are private company pay per use services.</i></p>

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ROADMAP WITH TIMELINE	<p>8. Roadmap: the timeline plan you have for using those assets: (what, where, to who, e.g. meeting with board to present them, inclusion in your portfolio in 1 year, etc.). Provide concrete actions</p> <p><i>Regarding the software assets, integration will remain operational in production, and the studies to integrate the components described above will start after the summer. Regarding the conceptual framework, covid crisis has delivered a big blow to personal networks. UJI plans to start recovering those bindings as restrictions disappear and socialization is recovered, disseminating SEAL in all available events. Can't foresee how many of them will present, but EUNIS and local NREN biyearly meetings will be the main and most sure targets. Other possible targets are the conference of rectors and Terena meetings, through the NREN collaboration.</i></p>
	<p>9. Measurement: how do you plan to measure impact of planned actions (some KPIs defined and criteria for success to reach)</p> <p><i>No formal framework has been defined yet: internal integrations are perceived as a gain, as allow automating formerly manual processes, but no quantitative figures will appear until the first analysis happens after summer. Regarding the conceptual framework dissemination, benefit is a long-term global benefit, too diffuse to analyse now, but this task is assumed bona fide by the university as part of its high-level goals of knowledge sharing.</i></p>
	<p>10. Numbers: if you can provide any figures as a reference point to show what is above, would be more than appreciated</p> <p>.....</p> <p>.....</p>

- Others, all not covered with questions above, but relevant for SEAL partner.

Individual Exploitation Plan of University of Málaga (UMA)

	QUESTIONS
PROFILE AND MOTIVATION	<p>1. Partner profile: brief introduction about your organization, explaining your background (technical or business) and what is your field of operation.</p> <p><i>The University of Málaga is a general studies university about to celebrate its fiftieth anniversary. UMA has an important presence in international mobility programmes, specially Erasmus+, and a well established reputation in technical fields having attracted important multinational corporations even inside campus. Many of the university research and administrative unites participate in international collaboration projects.</i></p>
	<p>2. Your motivation to participate in the project and commitment: why did you join consortium and your role in the project.</p>

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	<p><i>The University of Málaga, through the Central Computing Services Identity management and systems architecture team, has been involved in the development and deployment of identity federations at regional, national and international level since the mid-nineties. This involvement included participation in projects like eduroam, eduGAIN, REFEDS, SSEDIC, EWP 1 and 2, the Groningen Declaration Network, MyAcademicID and EDSSI. The SEAL consortium presented an interesting combination of technologies that could help advance eID use.</i></p> <p>3. Means to achieve your objectives: show that you have necessary background (resources, dedicated department or working group, infrastructure).</p> <p><i>The Identity Management team has accumulated very useful knowledge by collaborating in projects and contributing code to several identity related packages, or produced its own software like the DUMA identity panel or the UMA mobile App. All this was deemed useful contributions to the SEAL project.</i></p> <p>4. Opportunity which appeared/appears: your participation is the result of the real need of your customers (with whom did you speak, which client asks you to provide it, all existing/potential requests, etc.). For academic partner mention if SEAL is in line with other projects (continuation). If there are other opportunities in the pipeline when project finished?</p> <p><i>SEAL services and software constitute a very useful solution for reducing the workload in several identity related workflows in the University, especially those required for onboarding or authenticating persons. SEAL linked identities based on strong eID backed at the same time by government issued and academic ones are especially useful in identifying international mobility students.</i></p>
<p>WHAT AND WHY</p>	<p>5. Exploitable assets and results: Describe what assets (whether this involves specific components, tools, knowledge, methodologies, skills, etc.)</p> <p><i>SEAL linked identities can be directly consumed into the University identity management systems thanks to its support of SAML2 protocol. The mobile eMRTD components are also very useful as a source of validated information for the identity store. The identity management and linking dashboard, both mobile and web based, will be incorporated in the corresponding UMA applications.</i></p> <p>6. Rationale: Explanation of why are you interested on those assets (the added-value they provide), how do you plan to exploit them (academically or industrially: e.g. provide as commercial solution, certification services, standardization, consultancy, further R&D, Brand positioning)</p> <p><i>As already said, SEAL results can be directly incorporated in the University identity management workflows, both for identifying persons without having to incorporate their data in the central identity store and also for improving onboarding processes.</i></p>

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	<p>7. Your Value Proposition towards Joint Exploitation of SEAL: what do you propose to project, what benefits will be delivered to customer, end users, what components/interest do you share with other partners.</p> <p><i>Besides internal use, we will work into disseminating the results through our networks, especially in Spanish speaking countries in South America thanks to our connections to ARSEE. The main objective is to increase usage of SEAL solutions in order to gain critical mass.</i></p>
<p>ROADMAP WITH TIMELINE</p>	<p>8. Roadmap: the timeline plan you have for using those assets: (what, where, to who, e.g. meeting with board to present them, inclusion in your portfolio in 1 year, etc.). Provide concrete actions</p> <p><i>SEAL solutions will be gradually integrated into the identity workflows of the University during the next academic term (2021/2022). The dissemination efforts will start in the fall of 2021 with the Groningen Declaration annual conference in Toronto and, maybe the ARSEE annual conference or PESC fall data summit.</i></p>
	<p>9. Measurement: how do you plan to measure impact of planned actions (some KPIs defined and criteria for success to reach)</p> <p><i>We have no concrete measurement, beyond the number of services that will consume SEAL transported identities and the number of users that authenticate using SEAL.</i></p>
	<p>10. Numbers: if you can provide any figures as a reference point to show what is above, would be more than appreciated</p> <p>.....</p> <p>.....</p>

- Others, all not covered with questions above, but relevant for SEAL partner.

Individual Exploitation Plan of University of Porto (U.Porto)

<p style="text-align: center;">QUESTIONS</p>	
<p>PROFILE AND MOTIVATION</p>	<p>1. Partner profile: brief introduction about your organization, explaining your background (technical or business) and what is your field of operation.</p> <p><i>Founded in 1911, the University of Porto (U.Porto) is a benchmark institution for Higher Education and Scientific Research in Portugal and one of the top 200 European Universities according to the most relevant international ranking systems. The U.Porto combines high quality education focused on individual vocations and talents as well as market needs with the claim to being the greatest birthplace of science in Portugal. It is committed to converting into social assets the talent and innovation from its 14 faculties, one business school and over 50 research centres. The</i></p>

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U.Porto has the richest academic community in Portugal and brings together the country's highest ranked students, a highly qualified scientific and teaching staff and a growing number of international students, teachers and researchers. Its fully equipped campus embedded within the city guarantees an optimal academic, scientific, and also social and cultural experience.

2. Your motivation to participate in the project and commitment: why did you join consortium and your role in the project.

The University of Porto has much interest in joining such consortium as having the possibility of authenticating foreign students, and even our own, without having them registered in the system, prior to any commitment or just for some use cases are of great usability. Also, as this project is directly followed by the CSIRT team, there is a huge commitment that everything should be safely kept and developed, and the reason why we also showed interest in developing the persistent module functionalities.

3. Means to achieve your objectives: show that you have necessary background (resources, dedicated department or working group, infrastructure).

The CSIRT team of U.Porto is directly involved in this project, which is the same team that is also actively involved in the U.Porto connection to the EWP network. By connecting each of the persons that are working in those projects we were able to achieve a high level of understanding and commitment in reaching the proposed goals of integrating the services.

On the other hand, for the development of SEAL's persistence module, which is a secure module for saving/loading user information, the CSIRT provided proper knowledge and skills, joining forces to produce a high-level secure module.

4. Opportunity which appeared/appears: your participation is the result of the real need of your customers (with whom did you speak, which client asks you to provide it, all existing/potential requests, etc.). For academic partner mention if SEAL is in line with other projects (continuation). If there are other opportunities in the pipeline when project finished?

The University of Porto, namely the CSIRT team, has great insights on the EWP projects 1 and 2, and in the EDSSI project that has started meanwhile. This has allowed the different teams to interoperate in expanding the SEAL services to integrate and define practical use cases where SEAL can play a main role when integrated with such projects. Although the functionalities develop show a practical case where Universities can benefit from SEAL to fetch student up-to-date data from other institutions, we believe we can still work to expand this service to provide HEI with more information upon the student login with SEAL credentials.

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WHAT AND WHY	<p>5. Exploitable assets and results: Describe what assets (whether this involves specific components, tools, knowledge, methodologies, skills, etc.)</p> <p><i>The focus was in the U.Porto's EWP portal, which is responsible to fetch information from HEI through the EWP network. To make the integration of SEAL with these functionalities we must understand how SEAL works, what are the attributes that can be retrieved, and how the EWP networks and what information can we fetch with such attributes. As for the user perspective, everything is transparent, the user is completely agnostic of the technologies behind, with no need for support on the process, just choosing the login option he/she prefers and then the system should work completely alone to fetch more related information.</i></p>
	<p>6. Rationale: Explanation of why are you interested on those assets (the added-value they provide), how do you plan to exploit them (academically or industrially: e.g. provide as commercial solution, certification services, standardization, consultancy, further R&D, Brand positioning)</p> <p><i>There are several points that can be highlighted as added value:</i></p> <ul style="list-style-type: none"> • <i>The abstraction of the user from memorizing login details in each portal ;</i> • <i>The system does not have to store any personal information on the user ;</i> • <i>The system fetches the needed information from EWP, according to the attributes retrieved from SEAL, easing the engagement process in the portal's functionalities ;</i> • <i>The systems always have an up-to-date data, directly from the HEI that owns that data, which provides a higher level of confidence in such data ;</i> • <i>The user does not have to carry any information across HEI.</i>
	<p>7. Your Value Proposition towards Joint Exploitation of SEAL: what do you propose to project, what benefits will be delivered to customer, end users, what components/interest do you share with other partners.</p> <p><i>In line with the previous answer, for the end users there is a huge liability in the system, that can be split in two main user experiences.</i></p> <p><i>IRO's:</i></p> <ul style="list-style-type: none"> • <i>Data is fetched directly from the sending HEI, with a great level of confidence, with is always up-to-date ;</i> • <i>Decreasing the number of student data, specially passwords, saved in their systems, leading to less exposure ;</i> • <i>Faster process of data and mobility related information as most of it is treated automatically when fetched.</i> <p><i>Students:</i></p> <ul style="list-style-type: none"> • <i>The process, from a user perspective, is mostly transparent with few integration with the system to retrieve their data ;</i>

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	<ul style="list-style-type: none"> • <i>The user does not have to memorise every login details for each different institutions;</i> • <i>The student does not have to carry any information with him/her when moving across HEIs.</i>
ROADMAP WITH TIMELINE	<p>8. Roadmap: the timeline plan you have for using those assets: (what, where, to who, e.g. meeting with board to present them, inclusion in your portfolio in 1 year, etc.). Provide concrete actions</p> <p><i>During the next years, we will keep pushing the Top-Level management towards integrating SEAL usage into any University of Porto portal that needs external data, specially retrieve from EWP or similar networks, therefore keeping all the data synchronized between portals and mostly up-to-date.</i></p>
	<p>9. Measurement: how do you plan to measure impact of planned actions (some KPIs defined and criteria for success to reach)</p> <p><i>No formal framework for measuring the impact have been defined and/or developed but we have a straight connection to the IRO's service which gives as continuous feedback on their experience and their users experiences as well. We will keep adjusting the functionalities according to their needs.</i></p>
	<p>10. Numbers: if you can provide any figures as a reference point to show what is above, would be more than appreciated</p> <p><i>The numbers we can provide is that at the moment there are thousands of institutions connected to the EWP network, providing student data to their partner HEIs, and these numbers show us that each day we can easily connect more and more institutions with their students, by using the SEAL services to facilitate the process.</i></p>

- Others, all not covered with questions above, but relevant for SEAL partner.

Individual Exploitation Plan of Ministry of Digital Governance

	QUESTIONS
PROFILE AND MOTIVATION	<p>1. Partner profile: brief introduction about your organization, explaining your background (technical or business) and what is your field of operation.</p> <p><i>The Ministry of Digital Governance is a rather new entity (since 07/21) in the Greek government bringing together all the Information Technology and Telecommunications structures related to the provision of digital services to citizens and businesses in the country. Its strategic target is to develop the necessary framework in order to contribute to the establishment of the inclusive Digital Single</i></p>

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	<p><i>Market at European level and enabling citizens and businesses in Greece to truly benefit from interlinked and multilingual e-services.</i></p> <p>2. Your motivation to participate in the project and commitment: why did you join consortium and your role in the project.</p> <p><i>The Ministry of Digital Governance is coordinating activities with all other ministries, government agencies, and bodies, to ensure interoperability at all levels e.g. devices, networks, data repositories, services, people, sectors, authorities, communities. More specifically, the General Secretariat of Digital Governance and Simplification of Procedures which is engaged in the project, is also responsible for undertaking all necessary initiatives for simplifying administrative procedures across the Public Sector and transform them into digital processes, avoiding the development of digital red tape. The Greek node e-IDAS in terms of technical administration and EU Regulation alignment, is within the Ministry's responsibilities.</i></p> <p>3. Means to achieve your objectives: show that you have necessary background (resources, dedicated department or working group, infrastructure).</p> <p><i>The Ministry has the obligation to implement the required legal framework for the functioning of the Greek e-IDAS node. At the same time, the General Secretariat of Digital Governance and Simplification of Procedures collaborates closely with GRNET (National Infrastructures for Research and Technology) and the General Secretariat of Information Systems for the Public Administration to ensure business continuity of the Greek node, its upgrade and further development.</i></p> <p>4. Opportunity which appeared/appears: your participation is the result of the real need of your customers (with whom did you speak, which client asks you to provide it, all existing/potential requests, etc.). For academic partner mention if SEAL is in line with other projects (continuation). If there are other opportunities in the pipeline when project finished?</p> <p><i>e-IDAS legal and technical framework, is considered to be within Ministry's priorities and serves the government's digital transformation policy</i></p>
<p>WHAT AND WHY</p>	<p>5. Exploitable assets and results: Describe what assets (whether this involves specific components, tools, knowledge, methodologies, skills, etc.)</p> <p><i>The Ministry has a SPoC appointed to the EE for e-IDAS Regulation and also is responsible for the EU Digital Agenda national implementation. A lot of experience has been gained in the field of digital transformation, in all Public Administration policy areas. Furthermore, synergies with Public Bodies and the Private sector are considered an asset for the project.</i></p>

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	<p>6. Rationale: Explanation of why are you interested on those assets (the added-value they provide), how do you plan to exploit them (academically or industrially: e.g. provide as commercial solution, certification services, standardization, consultancy, further R&D, Brand positioning)</p> <p><i>It is within Ministry's mission to set the legal framework and be an enabler of the national technical infrastructure to promote or even establish digital services in all competent policy areas</i></p>
	<p>7. Your Value Proposition towards Joint Exploitation of SEAL: what do you propose to project, what benefits will be delivered to customer, end users, what components/interest do you share with other partners.</p>
ROADMAP WITH TIMELINE	<p>8. Roadmap: the timeline plan you have for using those assets: (what, where, to who, e.g. meeting with board to present them, inclusion in your portfolio in 1 year, etc.). Provide concrete actions</p> <p><i>The Ministry will continue working closely with the key stakeholders mentioned in question 3. above. Moreover, since it is part of the approval process for national participation in CEF funded Telecom proposals, will detect a potential network of synergies regarding digital identities. Last, but not least, will try to disseminate the project through the National Coalition for Digital Skills.</i></p>
	<p>9. Measurement: how do you plan to measure impact of planned actions (some KPIs defined and criteria for success to reach)</p>
	<p>10. Numbers: if you can provide any figures as a reference point to show what is above, would be more than appreciated</p>

- Others, all not covered with questions above, but relevant for SEAL partner.

Individual Exploitation Plan of GRNET

	QUESTIONS
PROFILE AND MOTIVATION	<p>1. Partner profile: brief introduction about your organization, explaining your background (technical or business) and what is your field of operation.</p> <p><i>GRNET – National Infrastructures for Research and Technology, provides networking and cloud computing services to academic and research institutions, to educational</i></p>

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bodies at all levels, and to agencies of the public, broader public and private sector. It is the National Research and Education Network (NREN) for Greece.

2. **Your motivation to participate in the project and commitment:** why did you join consortium and your role in the project.

GRNET holds a key role as the coordinator of all national e-infrastructures in Education and Research. It aims to contribute to initiatives that enable natural person identification and authentication and support the modernization of the academic procedures and services provided to students.

3. **Means to achieve your objectives:** show that you have necessary background (resources, dedicated department or working group, infrastructure).

GRNET has a long track record of accomplishments in the field of federated identity. It developed the identity federation in Greece (DELOS), which has been used by the academic community since 2009. GRNET is also a founding member of the eduGAIN global interfederation service. It has also been a key contributor to the AARC Blueprint Architecture and guidelines and the architecture working group in AEGIS. In addition, it has contributed to studies and development efforts for achieving standards-based technical interoperability between eIDAS and eduGAIN. It has been showcasing such interoperability through the GRNET eID Proxy in the context of a series of projects funded by the EC's Connecting Europe Facility (CEF) such as the

- *“Transformation of Greek e-Gov services to eIDAS Crossborder Services”*
- *CEF eID - e-Signature and Erasmus Student eCard in Greece,*
- *eThemisID: Integrating the Greek Justice System with eIDAS and e-signature services*
- *EDSSI*

Furthermore, GRNET has been developing the RCIAM solution for enabling research communities to securely access and share common resources and services. Leveraging the federated identities available from the global eduGAIN service, as well as identities from social identity providers (e.g. Google, Facebook, etc.), RCIAM enables research communities to securely authenticate and identify their users, organise them in groups, assign them roles and centrally manage access rights for their resources. RCIAM is based on a suite of open-source software solutions, including Keycloak, COmanage Registry and SimpleSAMLphp. RCIAM is used as the core infrastructure proxy for the European Open Science Cloud (EOSC) and for managing access to a number of e-Research infrastructures, including EGI, NI4OS-Europe, OpenAIRE, and DiSSCo. GRNET is also contributing to the delivery of the RCauth Online CA that can on-the-fly

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	<p>identify entities based on federated credentials and issue to them PKIX credentials in real-time, focussing on converting SAML-to-PKIX.</p> <p>GRNET has a dedicated department European Infrastructures and Projects Directorate from managing the European projects. The Department has a Unit for the Implementation of projects and a team for developing and operating the services. At the same time there is the GRE department for operating and supporting production services.</p> <p>4. Opportunity which appeared/appears: your participation is the result of the real need of your customers (with whom did you speak, which client asks you to provide it, all existing/potential requests, etc.). For academic partner mention if SEAL is in line with other projects (continuation). If there are other opportunities in the pipeline when project finished?</p> <p>GRNET participated in the project to enable the connection of the SEAL platform through the GRNET eID Proxy with the eIDAS-node infrastructure and the eduGAIN interfederation. This enabled the required validation workflow to allow the importing of eduGAIN academic attributes to the SEAL platform with the purpose of linking them with Personal Identification Information, retrieved from the eIDAS Network, and also deriving new privacy preserving identities.</p>
WHAT AND WHY	<p>5. Exploitable assets and results: Describe what assets (whether this involves specific components, tools, knowledge, methodologies, skills, etc.)</p> <p>GRNET is mostly focused on extending the functionalities of existing services, the developing of new techniques and solutions. The results of the project will help us to improve the services and update with new technologies.</p> <p>The following assets have been identified:</p> <ul style="list-style-type: none"> • GRNET eID Proxy service - integrated with the SEAL platform using standard interfaces in order to enable user authentication through the eIDAS-Node Infrastructure as well as the identity providers of universities and research institutes participating in the eduGAIN interfederation. • SEAL SSI Linking Service which offers SSI Issuer capabilities for generating tamper-free VCs derived by authenticating the users via authoritative sources like eIDAS and eduGAIN and the Service Provider API module that can be integrated to authenticate the users by validating VCs.

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	<p>6. Rationale: Explanation of why are you interested on those assets (the added-value they provide), how do you plan to exploit them (academically or industrially: e.g. provide as commercial solution, certification services, standardization, consultancy, further R&D, Brand positioning)</p> <p><i>It is within GRNET's role and research and development interests to provide such services. SEAL has provided additional knowledge, tools, and assets to be exploited in upcoming projects.</i></p>
	<p>7. Your Value Proposition towards Joint Exploitation of SEAL: what do you propose to project, what benefits will be delivered to customer, end users, what components/interest do you share with other partners.</p> <p><i>We have developed production level services which are used with the other SEAL partners and for additional eduGAIN and eIDAS connections.</i></p>
ROADMAP WITH TIMELINE	<p>8. Roadmap: the timeline plan you have for using those assets: (what, where, to who, e.g. meeting with board to present them, inclusion in your portfolio in 1 year, etc.). Provide concrete actions</p> <p><i>We will continue working with the key partners of the project. The eduGAIN and eIDAS proxies will continue to serve SEAL and the respective deployment will remain for two years after the termination of the project. We also intend to integrate some components as part of other eID solutions.</i></p>
	<p>9. Measurement: how do you plan to measure impact of planned actions (some KPIs defined and criteria for success to reach)</p> <p><i>We plan to include SEAL in GRNET portfolio of services regarding electronic identities' management. The impact can be measured by internal acceptance and by usage by other projects and also by customer feedback.</i></p>
	<p>10. Numbers: if you can provide any figures as a reference point to show what is above, would be more than appreciated</p> <p>.....</p> <p>.....</p>

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