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# EU Cross-border Service Delivery Analysis in the Context of eIDAS 2.0

Master's thesis

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TALLINNA TEHNIKAÜLIKOOL
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# Euroopa Liidu piiriülene digitaalne teenuspakkumine eIDAS 2.0 kontekstis

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Tallinn 2024

# Author's declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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# Abstract

This thesis examines the cross-border online service delivery across EU member states, with a particular focus on EUDI Wallet's implementation based on the new eIDAS 2.0 regulation.

To create an understanding of the current state of play in the EU cross-border online service delivery, this study explores the EUDI Wallet's implications on an already existing provision mean - Single Digital Gateway. In order to create the context of the EUDI Wallet and Single Digital Gateway's obstacles, the research identifies key barriers to integration, including differences in operational frameworks, authentication mechanisms, credential management, and privacy standards. This study focuses on Estonian eID ecosystem to address these challenges.

Based on the results of the analysis, the author proposes recommendations on how to prepare for the implementation of the EUDI Wallet when eIDAS 2.0 enters into force across EU member states. The author provides insights on how to ensure interoperability with the EU's Single Digital Gateway and prepare for their integration within different institutions to foster well-functioning digital ecosystems in EU member states.

This thesis is written in English and is 79 pages long, including 9 chapters, 6 figures and 3 tables.

Keywords: cross-border digital services, electronic identity, interoperability, EUDI Wallet, eIDAS, SDGR.

# Annotatsioon

# Euroopa Liidu piiriülene digitaalne teenuspakkumine eIDAS 2.0 kontekstis

Käesoleva magistritöö eesmärgiks on uurida piiriülese digitaalsete teenuste pakkumist Euroopa Liidu (ELi) liikmesriikides, keskendudes eelkõige ELi digiidentiteeditasku (EUDI Walleti) rakendamisele uue eIDAS 2.0 õigusraamistiku raames. Selleks, et luua arusaam ELi piiriüleste digitaalsete teenuste osutamise hetkeseisust, uuris autor EL digiidentiteeditasku mõju olemasolevale digitaalsete teenuste osutamise vahendile, milleks on ELi ühtne digivärav (Single Digital Gateway).

Konteksti loomiseks viis autor läbi dokumendianalüüsi ja temaatiliselt pool-struktureeritud intervjuud, et luua analüütiline ülevaade ELi digiidentiteeditasku rakendamisest ja piiriülese digitaalse teenuspakkumisega seotud peamistest barjääridest, tuues sealhulgas näiteid seotud strateegilistest ja õiguslikest raamistikest. Uuringus keskendutakse nende probleemide lahendamiseks Eesti eID-ökosüsteemile, mille põhjal viis autor läbi kvalitatiivse juhtumianalüüsi.

Analüüsi tulemuste põhjal pakub autor välja soovitused, kuidas valmistuda EL digiidentiteeditasku rakendamiseks eIDAS 2.0 jõustumisel ELi liikmesriikide lõikes. Autor annab ülevaate, kuidas tagada koostalitusvõime ELi ühtse digiväravaga ja valmistuda nende integreerimiseks erinevates institutsioonide üleselt, edendamaks hästi toimivat digitaalset ökosüsteemi kõigis ELi liikmesriikides.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 79 leheküljel, 9 peatükki, 6 joonist, 3 tabelit.

Võtmesõnad: piiriülesed digitaalsed teenused, elektrooniline identiteet, koostalitusvõime, EUDI Wallet, eIDAS, SDGR.

# List of abbreviations and terms

| | |
|---|---|
| ARF | Architecture and Reference Framework |
| DESI | Digital Economy and Society Index |
| DG CNECT | Directorate-General for Communications Networks, Content and Technology |
| DG DIGIT | Directorate-General for Digital Services |
| DG HOME | Directorate-General for Migration and Home Affairs |
| DG JUST | Directorate-General for Justice and Consumers |
| DG MOVE | Directorate-General for Mobility and Transport |
| EBSI | European Blockchain Services Infrastructure |
| ENISA | European Union Agency for Cybersecurity |
| EC | European Commission |
| eID | Electronic identification |
| eIDAS | Electronic Identification, Authentication and Trust Services |
| EIF | European Interoperability Framework |
| ENISA | European Union Agency for Cybersecurity |
| EP | European Parliament |
| EU | European Union |
| EUDI | European Union Digital Identity |
| GDPR | General Data Protection Regulation |
| GovSSO | Government Single-Sign-On |
| G2G | Government-to-government |
| G2C | Government-to-citizen |
| ITL | Estonian Association of Information Technology and Telecommunications |
| OOP | Once-Only Principle |
| OOTS | Once-Only Technical Solution |
| PID | Personal Identification Data |
| QTSP | Qualified Trust Service Provider |
| RIA | Estonian Information System Authority |
| SDG | Single Digital Gateway |
| SDGR | Single Digital Gateway Regulation |
| TARA | Trusted Authentication and Recognition Architecture |

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# 1 Introduction

In the light of the rapidly increasing trend of digitalisation, the European Union (EU) is pursuing the initiative to reshape the way people manage and verify personal information in their everyday lives. The electronic identification (eID) of a natural person and a possibility to authenticate to e-services is becoming more important than ever by playing a significant role in the lives of the EU citizens. This is supported by the Digital Decade Policy Programme 2030, where objectives and principles have been set for the EU's digital transformation (European Commission, 2024h).

The increasing reliance on digital credentials and the emergence of new related technologies have a significant impact on cross-border online services as well as credential verification processes. The European Union Digital Identity (EUDI) Wallet is a future cross-border online service delivery enabler, which is a significant part of the digitalisation strategies of the EC regulated within the eIDAS Regulation (*Regulation (EU) 2024/1183*, 2024) by the EU. It is intended to become a comprehensive solution for EU citizens that introduces an extensive concept of online identification across the union (European Commission, 2024b).

The ultimate goal of the EUDI Wallet is to offer every EU citizen a possibility to use their digital identity in their own country as well as all EU member states. The EUDI Wallet will fall under the EU Digital Identity Framework, recognised as the eIDAS Regulation (*Regulation (EU) 2024/1183*, 2024). This framework, which the EC started revising in 2021, builds upon the foundations laid by the original eIDAS Regulation (*Regulation (EU) 910/2014*, 2014), established in 2014. With a legal basis of the eIDAS Regulation, EUDI Wallet is expected to become a repository in all the EU member states for fundamental records of electronic attestations for different cross-border credentials like driver's licenses, academic qualifications, European Health Insurance Card and more. Implementation of the EUDI Wallet would allow the EU citizens to have their credentials secured in one place, meaning that they will not have to provide proof separately to authorities (European Commission, 2021b).

A formerly adapted Single Digital Gateway (SDG) is a cross-border service delivery mean, which brings together different public services in the EU for the citizens to use union-wide. It is based on a fundamental Once-Only Technical Solution (OOTS), which is also a widely recognised data sharing principle in public service provision (*Regulation (EU) 2018/1724*, 2018). SDG provides a functionality of creating a data sharing platform for using e-services across the EU. As the SDG has been already legally adapted within Single Digital Gateway Regulation (SDGR) (*Ibid.*) and implemented across European Union public and private sector organisations, it has several attributes that could create an overlapping condition in the future with the EUDI Wallet.

In the upcoming years, seamlessly operating digital cross-border services is amongst the objectives of the European Commission along with a resolution to have EUDI Wallet in place across the EU member states by 2026 (European Commission, 2024a). However, full implementation of the new service provision mean might cause complications between institutions and member states in the EU and create a possibility of reduced data exchange and unsuccessful integration of credentials throughout different organisations.

As the author has been previously involved throughout the studies with the topic of this research, some of the texts from the author's essays and research proposal in "Research Methods" and "E-Governance Technologies and Services Master's Project" courses have been used in this research.

## 1.1 Research purpose

This study serves a purpose of examining the EUDI Wallet's impact as a new cross-border service delivery mean across all EU member states and defining its legal and technical barriers. The research has a specific focus on analysing its compatibility with the SDG to understand the relationship between an existing online service delivery mean.

Taking into account the ongoing development and preparation of implementing the EUDI Wallet as a part of the new eIDAS Regulation (European Commission, 2021b), it will have a significant impact on the current EU member states' eID ecosystems. To create an understanding of the implications of the EUDI Wallet in a member state, the study is

illustrated by analysing Estonian eID ecosystem. Estonia demonstrates a great example of a successful e-government, where digital service provision covers 99% of state services (e-Estonia, 2024). Its citizens are also able to use several identification methods in Estonia and abroad. Therefore, this research focuses on Estonia to study the impact of a union-wide online service delivery solution on a member state that already has a well-functioning eID ecosystem. Semi-structured interviews and document analysis were conducted with digital public service providers in Estonia to map the current state of the art and relevant barriers.

## 1.2 Research motivation

The author's research motivation is based on the acquired knowledge from the E-Governance Technologies and Services master's programme studies as well as involvement in the data management related work in a European institution. This background sparked a significant interest for fast-evolving eID ecosystem within the EU, emphasised by the increasing necessity for digital identification across member states. This need is driven by facilitation of free movement for the citizens of the EU. However, the digital identity ecosystems across the EU are on different levels of maturity, not all equally conducive to cross-border eID (European Commission et al., 2022).

This research is essential for understanding the complexities of the EUDI Wallet future integration into EU cross-border eID systems as well as its compatibility with SDG, an existing service delivery mean. This research aims to bridge that gap by exploring the integration of cross-border credentials' verification methods with a focus on eIDAS and SDGR.

The Estonian eID ecosystem serves as a valuable case study, potentially offering insights about the future of the EUDI Wallet as well as country's best practices of eID means' implementation. This study is designed according to the needs of Information System Authority (RIA), who is testing EUDI Wallet implementation and integration with existing eID ecosystem from technical perspective. By addressing the identified research gap, this study aims to contribute with meaningful input for Estonian field experts as well as offering policy recommendations for the future EUDI Wallet implementation on the EU policy-makers level.

## 1.3 Research questions

Based on the research objective, the author developed two main research questions complemented by sub-questions that help to understand the scope. The following is the author's formulation of the first main research question:

**RQ1.** How does the integration of the EU Digital Wallet into cross-border service provision processes relate with the implementation of the Single Digital Gateway?

> **SRQ1.1.** Which frameworks are regulating the existing cross-border service provision?
>
> **SRQ1.2.** What are the barriers of the EU Digital Wallet and the Single Digital Gateway integration?
>
> **SRQ1.3.** Which legal frameworks can streamline cross-border service provision of the EU Digital Wallet and align with Single Digital Gateway objectives?

The first main research question focuses on exploring the relationship between the EUDI Wallet and SDG, alongside the comparison of their features and analysis of existing regulatory framework. The research will focus on the relevant documentation and expert interviews with a more specific focus on the theoretical and legal aspects to better understand the scope. This approach will enable the completion of the research in a changing environment, which will be supported by the second main research question which has a focus on the Estonian study. The second main research question focuses on exploring the EUDI Wallet's implementation from the chosen EU member state's position:

**RQ2.** What will be the implications of implementing the EU Digital Wallet in an EU member state?

> **SRQ2.1.** What are the preconditions of the EU Digital Wallet integration?
>
> **SRQ2.2.** Which authorities should be involved in the leading and implementation processes?
>
> **SRQ2.3.** What kind of challenges and opportunities are related to the EU Digital Wallet implementation in the EU Member state?
>
> **SRQ2.4.** What legal frameworks and agreements need to be established to ensure seamless cross-border services enabled by the EU Digital Wallet within an EU

member state?

Two main research questions and relevant sub-questions will be answered through the analysis of technical and legal documentation as well as qualitative expert interview analysis alongside with providing theoretical context. Based on the research outcome, policy recommendations and conclusions are provided on the EU and national level to support decision-making in the fast-evolving field.

## 1.4 Thesis outline

This master's thesis is divided into 8 chapters. The present and first chapter outlines the purpose and motivation of the thesis and presents the research questions. The second chapter provides an overview of existing literature in the field. The third chapter lays the theoretical groundwork, emphasizing the essential models that potentially frame and affect cross-border service delivery in the EU as well as Estonia. In the fourth chapter, the author describes the research methodology and design, detailing the approaches to data collection and analysis. The fifth chapter has a focus on providing the research background on cross-border service delivery means and its components. The sixth chapter gives an Estonian case overview by analysing its eID ecosystem. The seventh chapter offers a synthesis of the research results from data collection and evaluates the findings. The eighth chapter gives policy recommendations based on the conducted study. The final section recaps the core conclusions, defines limitations and suggests potential research directions for the future.

# 2 Literature review

This chapter is centred on providing an overview of existing literature in the European cross-border service delivery domain, looking into the academical research findings and gaps. This research has a main focus on the EUDI Wallet, which additionally requires familiarisation with the general findings about the topic to understand the existing background. Since this study entails cross-border service provision across Europe, the author will have a geographical focus on the scholarly literature in this region. For a thorough literature review, scientific databases like SCOPUS and Google Scholar were used. The author focused on scholarly literature that would reflect the findings in this research domain after 2014, when electronic identification and trust services for electronic transactions were first regulated in the EU by eIDAS legal framework (*Regulation (EU) No 910/2014*, 2014).

The trend towards digitalisation within the European Union has created momentum for establishing a fast, secure digital market. This evolution brings with it specific considerations for how cross-border services are provided (Maierhofer & Schimpe, 2022). The EU's push for digitalisation aims to consolidate citizens' data into one digital location - a wallet. The current literature lacks comprehensive analyses on how EUDI Wallet might influence the European Union and its member states. It is evident that as this specific solution has not been implemented in the EU yet, there are also not many tangible cases to analyse. Despite the growing relevance of digital identity wallets, there is little consensus on their definitions and functionalities, as highlighted in recent studies (Podgorelec et al., 2022; Sharif et al., 2022).

The eIDAS Regulation is the EU cross-border services facilitator, which gives a legal basis to EUDI Wallet (*Regulation (EU) 2024/1183*, 2024). It is a crucial facilitator of secure electronic interactions across EU member states. eIDAS provides the legal groundwork for the mutual recognition of electronic identification and trust services, which are fundamental to the future EUDI Wallet implementation (European Commission, 2023d). The regulation has been influential in enabling a variety of e-

services, by streamlining the identification process and reducing administrative burdens (Klobučar, 2019). The main concept of eIDAS is aligned with e-government goals and domestic cross-border initiatives, therefore it is in the member states' interests to implement it swiftly (Aavik & Krimmer, 2016). However, studies have shown that eIDAS faces various challenges from various aspects (Berbecaru et al., 2019; Busch, 2022; Hölbl et al., 2023; Klobučar, 2019). Lips et al. (2020) have highlighted key issues as legislation, interpretation, implementation, compliance and communication. In response to the evolving needs and the EC goals of digital age, the revised eIDAS Regulation was accepted by the European Parliament in February 2024 and European Council in March 2024 (European Council, 2024). Despite the scholarly speculations of the future of the renewed regulation, it has not been academically covered yet. This research aims to give insights into the new eIDAS through secondary data analysis.

In addition to the upcoming EUDI Wallet, Single Digital Gateway (SDG) has been serving its purpose as an existing cross-border service delivery mean that is governed by the Single Digital Gateway Regulation (SDGR) and supported by the eIDAS Regulation (*Regulation (EU) 2018/1724*, 2018). Previous studies have underscored the importance of the Single Digital Gateway (SDG) as a centralized platform for accessing various public services across the EU, emphasizing its role in fostering a more interconnected European e-government framework (Bhattarai et al., 2019). However, there is a notable research gap regarding how the SDG and the upcoming EUDI Wallet will interact and the implications of the EUDI Wallet's implementation in parallel with SDG. For instance, as one common area the EU has applied OOP in a regulatory framework for all the member states by adopting the SDGR (Kalvet et al., 2018), whereas it also aligns with the eIDAS Regulation. This study seeks to contribute to developing key insights on the integration and regulatory features between these initiatives.

Service provision between the EU member states necessitates an advanced level of interoperability, which is the subject of considerable academic interest. There is a recognised need for more research into the effectiveness of cross-border e-government cooperation (Chen et al., 2019). A high level of interoperability is essential for these services to function effectively, acknowledging the significant investments already made in existing infrastructures (Ribeiro et al., 2018). At the EU level, it is evident that interoperability is strongly intertwined with Once-Only Principle (OOP), which has been

established for easier and less unnecessary interactions between citizens and governments (Gallo et al., 2014). However, interoperability with the eID ecosystems between EU member states was not initially considered a priority, meaning that now those issues among digital identity systems present notable barriers to the integration of the EUDI Wallet and SDG (Shehu et al., 2019).

Ramon Gil-Garcia et al. (2007) describe how projects supporting information sharing can lead to various technical, organisational and political benefits. In order to achieve these advantages, it is important to map the barriers in different contexts within the scope of digital service provision in EU member states. These barriers span technological, legislative, organisational, political, managerial, and institutional dimensions, presenting a complex landscape that must be negotiated for effective digital service provision (Savoldelli et al., 2014). The context of current research revolves around mapping the barriers related to those domains and developing reasoned answers.

Given literature examples highlight how recent practices as well as scholarly research have enriched and covered the topic of current research. This relationship between foundational knowledge and contemporary studies emphasises the significance of this study. The literature review systematically maps the current state of cross-border digital services within the EU, highlighting the promising role of the EUDI Wallet and its relationship with the SDG. It identifies how regulatory frameworks are brought out by scholars as the key area of investigation, pinpointing existing legislative obstacles that could delay integration.

# 3 Theoretical framework

This chapter provides a theoretical framework for cross-border service provision in the EU and underlines the main models and concepts supporting the scope of this study. As this study focuses specifically on examining the integration of the EUDI Wallet as a new cross-border solution, the theoretical framework is based on the Wallet solution. The author uses Koppenjan and Groenewegen's framework on Institutional Design to describe the EUDI Wallet as a complex technological system (Koppenjan & Groenewegen, 2005). The author gives insight into Technology Acceptance Model (TAM) to create an understanding around the user acceptance perspective of the EUDI Wallet (Davis, 1989). To provide a specific theoretical EU focus, the author uses the conceptual model for integrated public services provision from the European Interoperability Framework (EIF) (European Commission, 2017).

## 3.1 Koppenjan and Groenewegen's institutional design

Koppenjan and Groenewegen's approach for institutional design is explored as a robust framework suitable for analysing complex and multi-layered institutional changes such as those required by the implementation of the EUDI Wallet. It is relevant to their framework, as Koppenjan and Groenewegen's description of a complex technological system aligns with the EUDI Wallet's characteristics, as shown in Table 1 (Koppenjan & Groenewegen, 2005).

Table 1. Complex technological systems vs. EUDI Wallet's characteristics.

Source: Koppenjan & Groenewegen (2005)

| Specific characteristics | EUDI Wallet's characteristics |
|---|---|
| Undisciplined technological component | User interface design, security features, interoperability standards |
| Multifactor systems | Integrates legal, organisational, semantic, and technical factors for cross-border functionality |

| Public and private parties involved | The EC, EU member states and private sector are the involved parties |
|---|---|
| Influenced by market forces and government regulations | Designed to comply with EU regulations (e.g., eIDAS, GDPR), influenced by digital market demands |

This framework is particularly suitable for describing the multifaceted nature of such a technological system, which integrates diverse elements ranging from user interface design to security features and involves multiple stakeholders including public and private sectors. The interplay of market forces and regulatory demands, which the EUDI Wallet must navigate, further emphasises the relevance of this framework. Additionally, the framework's focus on the dynamics between technological components and institutional settings supports a comprehensive understanding of how the EUDI Wallet functions across various EU member states, assisting in identifying potential challenges and solutions in its broader adoption. This analysis is crucial for ensuring the EUDI Wallet's alignment with EU regulations and its effectiveness in facilitating cross-border functionality (Koppenjan & Groenewegen, 2005).

Koppenjan and Groenewegen describe a complex technological system to have specific characteristics. According to those features, the comparison with EUDI Wallet's characteristics indicated that it can be defined to be a complex technological system. Based on that, the author aims to give a foundation to its design process by utilising the three approaches of design (*Ibid.*). It involves three design components that are in

symbiosis and describe the relationship of institutional design with technological and process design (*Figure 1*).
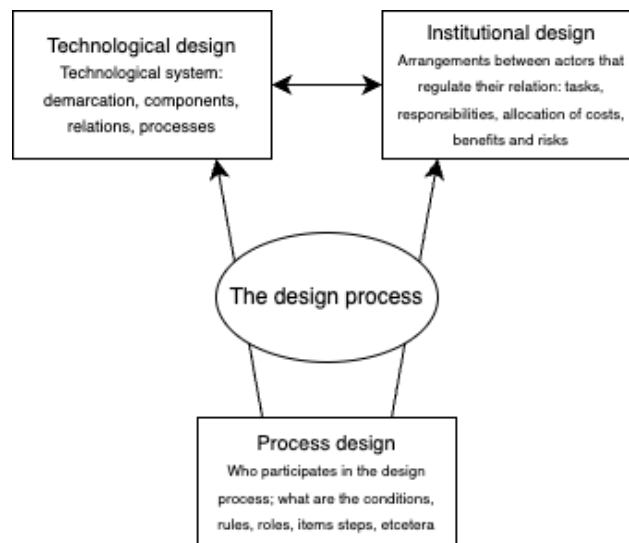


Figure 1. Institutional design positioning.

Source: Koppenjan and Groenewegen (2005)

**Institutional design** involves the arrangements between various parties that will govern their interactions within the system. The EUDI Wallet's implementation depends on the coherent collaboration between the EC, EU member states and the private sector (European Commission, 2021c). This design approach encompasses the development of policies and regulations that will oversee the EUDI Wallet's functionalities and simplifies this complexity through standardised guidelines and clear governance structures, enhancing the EUDI Wallet's acceptance across EU member states (Koppenjan & Groenewegen, 2005).

For the EUDI Wallet, the **technological design** includes the architecture of the digital wallet system. This includes the user interface design, the security features, and the technical specifications required for interoperability across the member states' digital identity systems. The technological design must ensure that the system is user-friendly, secure, and capable of handling cross-border identification and transaction processes (Koppenjan & Groenewegen, 2005).

The **process design** element highlights the collaborative aspect of the design for the EUDI Wallet: identifying involved parties, setting the conditions, establishing rules, defining

roles and the procedural steps. The process design must ensure that all relevant parties have a say in the development of the EUDI Wallet. It also outlines the process for iterative testing, feedback collection, and the general actions to improve the wallet to ensure it meets its objectives. Such adaptability is crucial for long-term sustainability and relevance in the dynamic digital landscape of the EU (Koppenjan & Groenewegen, 2005).

Koppenjan and Groenewegen's framework provides a structured approach to managing the complexities of implementing the EUDI Wallet. This strategic approach helps to define the institutional structure in which the EUDI Wallet can effectively serve its purpose while adapting to future challenges and opportunities.

## 3.2 Technology Acceptance Model

The Technology Acceptance Model (TAM) has been a continuously relevant theoretical model in the field of information systems for years (Lee et al., 2003). TAM, originally proposed by Davis in 1985, is fundamentally about understanding how users come to accept and use technology. TAM provides a basis for evaluating the user acceptance of information systems and predicting how changes in system design, or other factors might impact system usage (Davis, 1989). This model is relevant for providing a framework for the acceptance of the EUDI Wallet in the EU member states, as Davis emphasises two primary factors: perceived usefulness and perceived ease of use. These factors are critical in predicting and enhancing user acceptance and usage behaviour of information systems. Both factors provide insightful support for service or technology providers to evaluate the user interest regarding the new design concept as well as and information systems managers to assess the offerings from vendors within user organisations (*Ibid.*).

### 3.2.1 Perceived usefulness

In the TAM framework, perceived usefulness is defined as "*the degree to which an individual believes that using a particular system would enhance their job performance*" (Davis, 1989, p. 320). In the context of the EUDI Wallet, this translates to the degree to which EU citizens believe that the wallet will enhance their ability to access cross-border services efficiently and securely. The wallet's integration into the EU member states' eID ecosystems offers a streamlined, standardised method for identity verification across Europe, potentially increasing its perceived usefulness. Highlighting the wallet's capacity

to reduce bureaucratic overhead and simplify transactions in multiple jurisdictions can significantly influence the user's adoption decision (*Ibid.*).

### 3.2.2 Perceived ease of use

Perceived ease of use is defined as a concept in which a person believes that using a system would be free of effort (Davis, 1989, p. 320). For the EUDI Wallet, ensuring a user-friendly interface and minimising the complexity of obtaining and using the wallet are essential. The interface must be intuitive, which would also serve a broad demographic spectrum, taking into account e.g., the digital divide or those less technologically skilled (Davis, 1989). "*If user acceptance testing proves successful in explaining user acceptance, it would provide valuable information for system designers and implementors. Designers would be better equipped to evaluate design ideas early in the system development process and make informed choices among alternative approaches. This would enable them to direct development resources toward high priority systems and reduce the risk of unsuccessful designs.*" (Davis, 1985, p. 12). Simplifying these processes can help ease potential resistance to new system adoption, aligning with the Koppenjan & Groenewegen's institutional design principles that stress the importance of user-centric technological designs.

Applying the TAM to the implementation of the EUDI Wallet helps identify specific user-centric strategies to facilitate the wallet's adoption among the EU member states and their private and public sector organisations, emphasising the importance of perceived usefulness and ease of use. This framework does not only focus on user acceptance from a psychological perspective but also seamlessly offers integration with structural and regulatory dimensions, ensuring a comprehensive approach to supporting the EUDI Wallet's acceptance across the EU.

## 3.3 European Interoperability Framework

EIF serves as a cornerstone for cross-border service delivery at a regional, national and EU level, thus providing support for integrating digital service provision solutions like the EUDI Wallet as well as the SDG. As outlined by Wimmer et al. (2018), interoperability governance is critical for the diffusion of such services across the EU. The EIF outlines a multi-layered approach to interoperability (*Figure 2*), emphasising the

need for a universal governance model that includes various dimensions (European Commission, 2017).
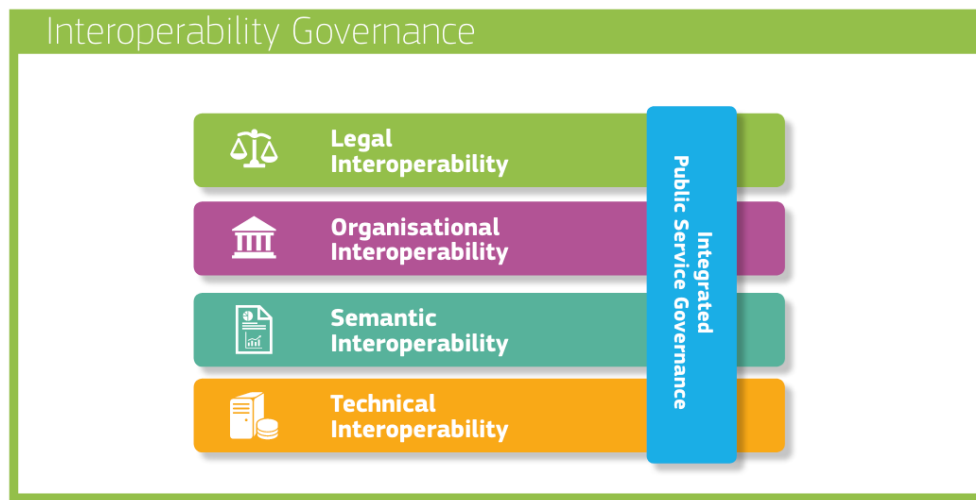


Figure 2. EIF Interoperability Governance framework.

Retrieved entirely from: European Commission (2017)

In the context of the EUDI Wallet, which aims to provide citizens with a trusted and secure digital identity for online services, implementing the interoperability governance approach of EIF supports seamless cross-border access of identity verification and related online services. The model integrates legal, organisational, semantic, and technical factors for cross-border functionality (*Ibid.*).

### 3.3.1 Legal interoperability

Legal interoperability between EU member states ensures that the EUDI Wallet is adopted widespread and without discrimination. Harmonisation of eIDAS with national legislation, data protection laws (GDPR), and existing cross-border service provision laws (SDGR) ensures the EUDI Wallet's eligibility. This includes establishing legal agreements or mutual recognitions among EU countries to accept digital identities and signatures enabled by the EUDI Wallet. Additionally, legal interoperability encompasses the alignment of data protection requirements across EU member states to protect personal data and privacy within digital transactions (European Commission, 2017).

### 3.3.2 Organisational interoperability

This principle involves aligning governance structures, business processes, and administrative boundaries to support the functioning of the cross-border service provision

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mean. It encompasses the collaboration between different governmental bodies, the private sector, and EU citizens. Organisational interoperability necessitates standard operating procedures for identity verification, user authentication, and data exchange protocols that work across different public administrations and service providers (European Commission, 2017).

### 3.3.3 Semantic interoperability

Semantic interoperability addresses the meaning of data exchanged through the cross-border service provision, ensuring that information is understood in the same way across all EU member states. It is critical for the effective exchange and interpretation of data, such as personal identification details. Standardising data formats, terminologies, and ontologies is crucial so that one member state user's personal data is accurately interpreted in another EU country, avoiding errors in service delivery (European Commission, 2017).

### 3.3.4 Technical interoperability

Technical interoperability is rather tangible, relating to the integration of IT systems and services to allow data to flow freely and securely across different platforms. This means creating common interfaces and protocols to enable interactions between various national digital identity systems and the EUDI Wallet's platform. It involves adopting standards and ensuring secure communication channels for data transmission, along with interoperable formats for cross-functionality (European Commission, 2017).

EIF's multi-layered interoperability governance model provides support to the successful implementation and broad acceptance of the EUDI Wallet. This framework offers a structured approach to ensuring that the various systems involved in the EUDI Wallet are interoperable not only on technical levels but also legally, organisationally, and semantically across all EU member states. By adhering to EIF guidelines, this research demonstrates how the EUDI Wallet aligns with EU standards for digital identity solutions, enhancing trust and efficiency in cross-border digital services.

# 4 Research methodology

This chapter gives an overview of the research design and justifies the methodological approach. Author has identified and implemented the following methodology in this study to fulfil the aim of the research through answering the posed research questions.

## 4.1 Research strategy

Research goals and objectives are in accordance with the qualitative approach of this study. Employing a qualitative approach allows for a deep, contextual understanding of the complex interrelations within policy frameworks and strategic decisions, crucial for understanding the Estonian case (Creswell & Poth, 2016).

This research employs a case study methodology to understand the topic in the real-world setting. It allows for the gathering of additional information about the subject and the exploration of existing literature to describe their linkages between real-world practices, making the case study approach relevant in this research (Runeson et al., 2012).

This study seeks to look into the future of EUDI Wallet integration in the EU member states' eID ecosystems, making the research exploratory or "content-driven" due to the need to generate new data to find answers to the posed research questions (Guest et al., 2011). According to Yin (2018), case study research questions should ideally begin with "how" and "why" to align with design needs. Since this study utilises the exploratory aspect of case study research, "what" questions are mainly used for research questions in this study (Guest et al., 2011).

Specific cases relevant to Estonian eID ecosystem will be analysed to provide a deep understanding of the challenges and opportunities associated with the EUDI Wallet integration as a cross-border service delivery mean. Moreover, the subject of this research needs to be supported by a case study approach due to its applicability in circumstances where results are unclear and undefined (Yin, 2018). Creswell & Poth (2016) indicate that qualitative research is appropriate if the existing theories do not exist. As the EUDI Wallet is connected to the adoption of the new eIDAS Regulation on the EU level, which

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is currently in progress, case study methodology helps to support a valid research outcome.

Triangulation research strategy was a chosen approach to gather knowledge through methodological triangulation to enrich the research findings (Runeson et al., 2012). At the level of data triangulation, semi-structed field expert interviews and documentation analysis was used to collect and compare data from different sources to get comprehensive data for this study (*Ibid.*).

The author's overall research is schematically visualised in Figure 3 as follows:
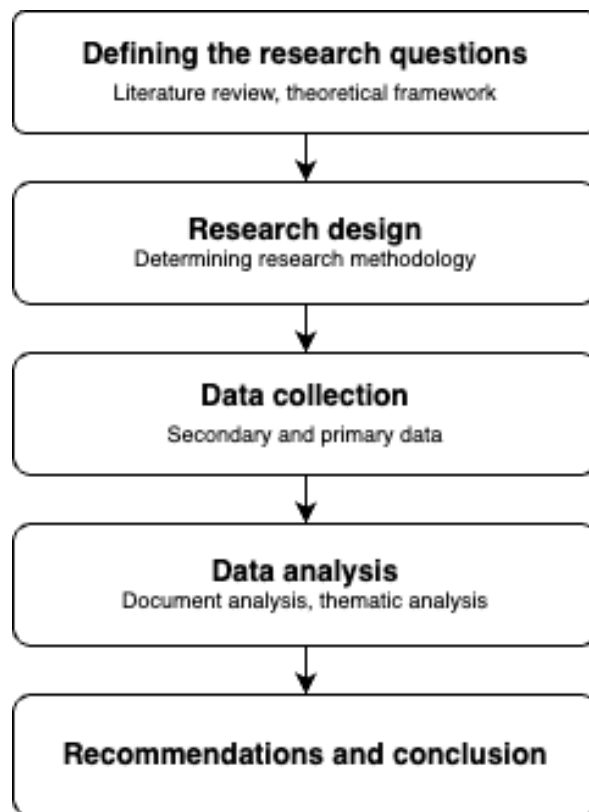


Figure 3. Overview of the research process.

## 4.2 Data collection

This case study approach requires data collection from different sources to conduct a comprehensive examination of both the phenomenon under study and its surrounding context (Yin, 2018). Therefore, primary and secondary sources are used to comply with the scope of the study, as shown in Figure 4:
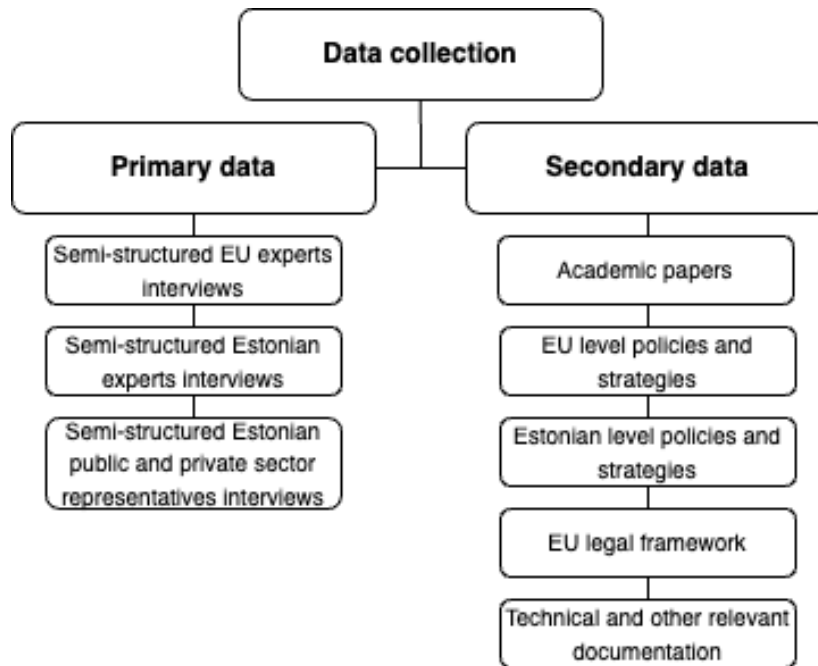
Figure 4. Primary and secondary data used for data collection.

The research begins with the analysis of secondary data. Secondary data sources were applicable academic literature, EU and national level policies, EU legal framework (main focus on eIDAS 2.0), technical documentation, strategies and relevant information from official institutions.

For primary data collection, semi-structured interviews were conducted with key field experts from the European Union and Estonian policy-makers level. Three different sets of interview questions were designed based on the participants background and field of work to get valuable data according to their expertise. The first set of questions was designed according to the EU policy-makers background. The author compiled the second set of questions based on the Estonian policy-makers background. The third set of questions took into account the work domain of Estonian key stakeholders in the scope of cross-border service delivery processes mainly from the user perspective. Detailed interview questionnaires are presented in English in Appendix 1, Appendix 2 and Appendix 3 of this thesis.

Purposeful sampling is used as a method to select interviewees for the data collection in the form of semi-structured interviews. This strategy is beneficial for gathering detailed information from a diverse group of key experts and stakeholders, who have extensive

knowledge in cross-border service delivery processes or who have been involved in the development of digital identification solutions (Palinkas et al., 2015).

## 4.3 Data analysis

The analysis focused thematically on three main aspects of this research: EUDI Wallet implementation in the EU, EUDI Wallet implementation in Estonia and comparison of the EUDI Wallet and SDG. To get the user perspective from public and private sector key experts, interviews were conducted with an aim to obtain information from the key decision-makers within the domain of the EUDI Wallet and SDG. The selection of the EU level experts was done to get a wider, EU level perspective from the primary decision-makers. Estonian experts' selection was based on their high-level position and regular involvement with the EUDI Wallet as well as SDG to get the most accurate input for the scope of this study.

The target group of selected experts formed as follows: 2 experts from the EU decision-makers level, 3 experts from the Estonian decision-makers level and 3 experts from the Estonian public and private sector stakeholders' level. An overview of the participants is provided in the following table (*Table 2*):

Table 2. Overview of the interviewees.

| Organisation's name | Role | Interview Format | Date |
|---|---|---|---|
| European Commission | IT Product Officer, DG DIGIT | On-site interview | 31.01.2024 |
| European Commission | Seconded National Expert, DG CNECT | Teams Recording | 06.02.2024 |
| Estonian State Information System Authority | Head of the eID Department | Teams Recording | 14.03.2024 |
| Ministry of Economic Affairs and Communications | Adviser on better regulation and the Single Digital | Teams Recording | 22.03.2024 |

| | Gateway for the European Union | | |
|---|---|---|---|
| Ministry of Economic Affairs and Communications | Counsellor to the Minister in the Ministry of Economic Affairs and Communications | Teams Recording | 27.02.2024 |
| Estonian Transport Administration | Chief Information Technology Architect; Driving Rights Service Manager at the Driving Licence Department | Teams Recording | 03.04.2024 |
| SEB Bank | Chief Product Owner Digital Channels | Teams Recording | 22.03.2024 |

Author conducted the interviews electronically or in the location of the interviewees. Interviews were held in English or in Estonian and recorded digitally with interviewees' prior consent to create transcripts for further analysis.

The process involved the transcription of all interviews, resulting in approximately 80 pages of transcribed material. This data went through detailed coding process, where it was organised thematically according to the questions posed during the interviews. A qualitative software programme NVivo was used for the data coding. This helped to gather large set of transcription data, which was then compared, thoroughly analysed, and interpreted to gather insights with the software. The themes identified in the analysis were directly derived from the semi-structured interview questions, which were specifically designed to explore the implementation and impact of the EUDI Wallet and SDG at both EU and national levels. Throughout the coding process, these themes naturally emerged as the primary categories of discussion, reflecting the focused insights and perspectives shared by the interviewed experts. Results are presented in Chapter 7.

# 5 Research background

This research chapter outlines the scope of cross-border service delivery within the European Union (EU), with a focus on regulatory eIDAS and SDGR frameworks and existing provision methods EUDI Wallet and SDG. The core is to examine the ecosystem revolving around the EUDI Wallet in facilitating and governing cross-border credentials.

Digital identity has become very topical and crucial in the global and national strategies. Recommendations by OECD in the domain of electronic authentication (OECD, 2007) as well as governing digital identity ecosystems (OECD, 2023) provide general guidance for governments around the world. The EU recognised the need for electronic identification in 1999, when the EU adopted the Electronic Signatures Directive (Directive 1999/93/EC). In 2015, a key effort to facilitate cross-border digital public services was the establishment of the Digital Single Market. This initiative seeks to develop an environment where citizens and businesses can utilise online services regardless of where they live (Krimmer, Dedovic, et al., 2021). The EC has set a European-wide commitment to make Europe digital by 2030 through establishing the Digital Decade Policy Programme (European Commission, 2023a).

## 5.1 eIDAS

The eIDAS Regulation, established in 2014, introduced a unified European framework for electronic identification and trust services, thereby simplifying the online public service provision of services in EU countries (*Regulation (EU) 910/2014*, 2014). It serves its purpose by allowing EU citizens to identify themselves electronically and use eID systems across the EU member states. Regulation has undergone significant alterations and has evolved into a new, European Digital Identity Framework, or eIDAS 2.0 (*Regulation (EU) 2024/1183*, 2024).

The new regulation has been amended according to the feedback based on the first version of the regulation. Revised eIDAS 2.0 version has transitioned from federal identities to

self-sovereign identity to meet the EUDI Wallet's purpose by giving the users an authority to manage personal data themselves (Sharif et al., 2022). The document underscores the importance of remote attestation technologies, which could be a key to enhancing trust in wallet apps across various devices (Czerny et al., 2023). Appropriate amendments taken into consideration, the eIDAS 2.0 was accepted by the European Parliament towards the end of February and was officially published in the EU Official Journal on April 30, 2024 (*Regulation (EU) 2024/1183*, 2024). Subsequently, eIDAS 2.0 will enter into force on May 20, 2024 and will be fully implemented by 2026 (European Council, 2024).

Under the existing and new eIDAS regulation, EU member states must facilitate cross-border electronic transactions by recognising each other's electronic identities (*Regulation (EU) 910/2014*, 2014; *Regulation (EU) 2024/1183*, 2024). If an EU country provides online public services, it has an obligation to recognise the notified eIDs of other member states. As of 2023, 23 countries out of 27 member states have at least one notified eID scheme to the eIDAS framework, indicating that not all EU countries are familiar with the eID ecosystem implementation (European Commission, 2024c). Moreover, the eID frameworks also vary significantly across the European Union. Some countries, like Belgium, possess digital identity systems initiated and managed by the government, while others, such as Nordic region countries, feature digital identity infrastructures are led by private banking institutions (Busch, 2022).

National identity management systems are interconnected via eIDAS-Nodes to facilitate this. EU member states are responsible for implementing at least one eIDAS-Node. (European Commission, 2023d). This technical interoperability aspect ensures that electronic identifications and trust services are uniformly recognised across the EU, enhancing the functionality and reliability of cross-border online services. However, adjustments are expected for eIDAS-Nodes interaction. For instance, challenges in identity matching arise due to some member states' lack of persistent identifiers and no access requirements for data exchange between two eIDAS services (Lips et al., 2022). Moreover, with the emergence of the future EUDI Wallet and its own technical requirements (European Commission, 2024j), there is also a question whether the member states choose to maintain their eIDAS-Nodes or these would starting losing their usability after the wallet's adoption.

The EC has acknowledged the importance of advancing the eIDAS framework to better support the EU single market. However, details on how the suggested modifications will streamline technical specifics remain limited. Notably, there is a lack of clear strategy for tackling known authentication security concerns highlighted by ENISA (The European Union Agency for Cybersecurity), as well as integrating biometric data usage within the confines of the GDPR and addressing cybersecurity responsibilities of device providers (Hölbl et al., 2023).

## 5.2 EUDI Wallet

The 2030 Digital Decade Policy Programme aims to achieve EU citizens empowerment through the development of cutting-edge technologies for people. The EUDI Wallet represents a fundamental advancement in digital integration that has a resolution to ensure a digital identity for all EU citizens (European Council, 2024). The EUDI Wallet allows EU citizens to interact with public administrations, verify their identity, and access services irrespective of the member state they are dealing with.

Within the upcoming eIDAS 2.0, the EC has defined the EUDI Wallet to be "*a product and service that allows users to store identity data, credentials and attributes linked to their identity, to provide them to service providers on request and to use them for authentication, online and offline, and to create qualified electronic signatures and seals.*" (European Commission, 2021b). The EUDI Wallet is structured around three core principles that aim to revolutionise the management and use of digital identities within the EU:

- *"made available to anyone who wants to use it: Any EU citizen, resident, and business in the EU who would like to make use of the EU Digital Identity will be able to do so;*
- *used widely: EU Digital Identity Wallets will be used as a way to identify users when providing them with access to public and private digital services across the EU;*
- *controlled by users: The EU Digital Identity Wallets will enable people to choose and keep track of their identity, data and certificates which they share with third parties. Anything which is not necessary to share will not be shared."* (European Commission, 2024j).

Firstly, the EUDI Wallet is made universally accessible, which promotes inclusivity and widespread adoption across diverse demographic and business sectors within the EU. Secondly, it is designed for extensive use across both public and private sectors, which is critical in facilitating seamless access to a variety of digital services, enhancing user convenience and operational efficiency. Lastly, the user-centric approach not only enhances trust and security but also aligns with broader EU values of data protection and privacy rights (*Ibid.*).

After the adoption of eIDAS 2.0, it is now mandatory for the EU member states to provide at least one wallet solution for their citizens (*Regulation (EU) 2024/1183*, 2024). To prepare for the upcoming EUDI Wallet, the eIDAS Expert Group put forth a comprehensive document to develop the EU Digital Identity Wallet Toolbox, which contains the Architecture and Reference Framework (ARF) as a basis to help the member states with Wallet's building blocks (European Commission, 2024e). ARF includes a set of standards and technical specifications, which help to navigate in the EUDI Wallet's ecosystem (European Commission, 2024j).

Figure 5 illustrates a more detailed structure of interactions within the eIDAS 2.0 architecture reference framework, focusing on different providers and their roles.
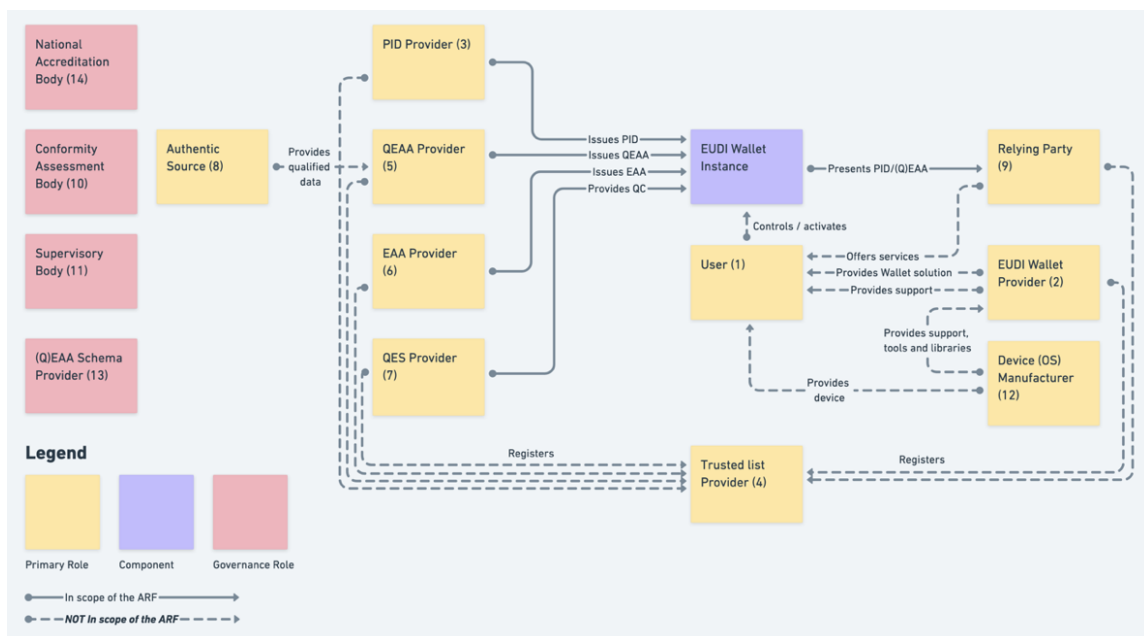


Figure 5. Model of the EUDI Wallet roles by ARF.

Retrieved entirely from: European Commission (2024j)

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The eIDAS Expert Group has mapped out entities which all interact with each other to provide a comprehensive eID system within the EUDI Wallet. The diagram indicates the primary roles, components and governance roles, highlighting the extensive governance and compliance mechanisms required under the eIDAS 2.0 framework. There is also room left for variations. For instance, in case of Person Identification Data (PID) Providers, the same organizations that currently issue official identity documents and electronic identity means might also serve as PID Providers, including EUDI Wallet Providers. However, it's possible that EUDI Wallet Providers and PID Providers are not the same entities (European Commission, 2024j). It is evident that the EUDI Wallet roles' structure is complex by its nature, in which case the Koppenjan and Groenewegen's complex technological system theory was deployed for the research to understand this multilayer phenomenon.

From the functional capabilities' point of view, the EUDI Wallet provides identification and authentication to access online services (*Ibid.*). The eIDAS expert group has listed relevant use-cases in the ARF that the EUDI Wallet entails:

- educational credentials;

- professional certificates;

- mobile driving licenses;

- access to health data;

- digital finance;

- digital travel credentials (*Ibid.*).

In order to test out those use-cases and have an overview of the EUDI Wallet's future scenarios, four Large-Scale Pilot (LSP) projects were launched by the EC in April 2023, all led by member states. LSPs ensure that the EU member states will have a tested code base for them to build wallets in their own country (European Commission, 2024f).

As the current state-of-play refers to the EUDI Wallet as a form of a prototype that will be implemented across the EU in 2026, the model has not been applied in the member states yet. For that matter, an open-source code is available to the public, which enhances interoperability and transparency by providing guidance and common standards (European Commission, 2024g).

## 5.3 Single Digital Gateway Regulation

The Single Digital Gateway Regulation (SDGR), established by Regulation (EU) 2018/1724, was adopted with a goal to simplify the EU digital landscape for its citizens and businesses (Regulation (EU) 2018/1724). SDG acts as a basis for a centralised digital access point to information, administrative procedures, and assistance and problem-solving services. Through the access point (Your Europe portal), interactions within the internal market enable individuals and businesses to effortlessly access information and services across national borders (European Commission, 2024d).

The SDG's primary role is to make the EU's single market more accessible and to strengthen the provision of digital public services. This is achieved by providing key public services online, including those required for cross-border activities (*Ibid.*). In its Annex II, SDGR includes 21 procedures related to the life services that are the following:

- Birth;
- Residence;
- Studying;
- Working;
- Moving;
- Retiring;
- Starting, running and closing a business (European Commission, 2023c).

SDGR requires information about administrative procedures of listed services to be available on national websites and presented in a manner that is clear, accessible, and consistently updated. However, these requirements have been identified as significant challenges by the EC, where member states need to improve their digital services (European Commission, 2021a).

For online service provision, SDGR is built on the Once-Only Principle (OOP), which is described in the regulation as follows: "*In order to further facilitate the use of online procedures, this Regulation should, in line with the 'once-only' principle, provide the basis for the creation and use of a fully operational, safe and secure technical system for the automated cross-border exchange of evidence between the actors involved in the procedure, where this is explicitly requested by citizens and businesses.*" (*Regulation*

*(EU) 2018/1724*, 2018). OOP is there to ensure that the European citizens do not have to share their data more than once while using online services.

Kalvet et al. (2018) identified that while the potential benefits of OOP-based cross-border e-government services are significant, there are also substantial barriers, including legal and technical challenges, that need to be addressed. That indicates the need for EU member states to synchronise legal frameworks and technological infrastructures to use the full potential of the OOP, which could lead to facilitating smoother cross-border service delivery and enhancing the efficiency of public administrations across Europe.

The Once-Only Technical System (OOTS) project was launched in 2023 as the core infrastructure, marking an achievement of the SDG (European Commission, 2024d). It illustrates the practical application and challenges of implementing the OOP and SDGR within the EU's digital single market framework. By focusing on federated architecture and sustainable pilot projects across various domains, OOTS demonstrates how cross-border collaborative efforts can enhance public administration efficiency and service delivery, contributing significantly to the digital single market's objectives (Prentza et al., 2021).

## 5.4 Synergies between EUDI Wallet and SDG

OOP is a principle that both eIDAS and SDGR share. The eIDAS regulation directly supports the OOP's goal of ensuring that citizens and businesses need to provide their information only once to public administrations (*Regulation (EU) 2024/1183*, 2024), which then share this data across borders, thereby reducing administrative burdens (Krimmer, Prentza, et al., 2021). The SDGR acts as both an enabler and a barrier for the implementation of the OOP across Europe by creating a legal framework for direct digital evidence exchange between public administrations in different Member states (Graux, 2021).

To understand the relation between EUDI Wallet and SDG, the EC contact group has mapped down synergies shared by the EUDI Wallet and OOTS in an interim report (European Commission, 2024i). As EUDI Wallet and OOTS are expected to fulfil similar

purposes, e.g., easier documents issuance for citizens and businesses, the synergies mapping facilitates defining the boundaries between both means (*Ibid.*). In light of the working group's report, it is evident that the EUDI Wallet is well supported by the Once-Only Technical System (OOTS).

The mapped synergies, particularly in user experience and investment, demonstrate an existing alignment with the Once-Only Technical System (OOTS), facilitating more efficient and secure digital interactions across EU member states. The report has emphasised five synergies that the EUDI Wallet and OOTS share:

1. "*Synergy 1: The EUDI Wallet provides an additional way for citizens and businesses for authentication and identification purposes when using the Once-Only Technical System.*

2. *Synergy 2: The preview area may offer the option for the user to start the process of issuance of the evidence in the EUDI format. Upon finalisation of the procedure, competent authorities may offer the option to issue the output of the procedure in the EUDI format.*

3. *Synergy 3: Citizens and businesses can combine evidence uploaded from the EUDI Wallet with evidence retrieved through the Once-Only Technical System.*

4. *Synergy 4: Qualified Trust Service Providers (QTSPs) could use the Common Services of the Once-Only Technical System to discover the authentic sources of evidence. The QTSPs could also use the Once-Only technical system message exchange protocol and operational framework to request the attributes from the authentic data source (as per requirement Article 45d of the eIDAS proposal).*

5. *Synergy 5: Citizens and businesses could use the Common Services of the Once-Only Technical System to discover the authentic sources able to provide QEAA and EAA.*" (European Commission, 2024i).

As these initiatives continue to evolve, their synergistic relationship promises to foster a more interconnected and streamlined digital landscape, aligning well with the broader objectives of enhancing user experience and investment efficiencies in the EU's digital governance. In conclusion, it has been recognised that the EUDI Wallet and SDG share foundational similarities in cross-border service delivery.

# 6 Estonian eID ecosystem overview

This chapter gives an overview of Estonia's eID ecosystem, emphasising its main components in online service delivery as well as the current state-of-play regarding the EU cross-border service provision methods EUDI Wallet and SDG.

Estonia has a strong emphasis on continuously evolving into a more digitalised society. Based on the eGovernment Benchmark report, Estonia ranked 2nd in overall digital government maturity in Europe (European Commission et al., 2023). According to DESI in 2023, Estonia ranks 3rd among EU member states for digital public services provision for citizens and businesses, making the country's eID ecosystem sufficiently robust for cross-border service delivery (European Commission, 2023b). There are governmental strategy papers like Digital Society 2030 highlighting the country's overall satisfaction with digital services as well as indicating the need for cross-border services in which case the Estonian government is doing directed cross-border cooperation with other countries (e.g. Finland) (Ministry of Economic Affairs and Communications, 2021).

Estonia has provided all of its citizens with a digital identity and access to e-services provided by public and private sector organisations. As 99% of Estonian public services are provided online, citizens find usability to their digital identity on a daily basis (e-Estonia, 2024). Estonian eID ecosystem allows users to identify themselves with three identification means used on a national level:

1. **ID-card** (provided by the government);
2. **Mobile-ID** (provided by the government);
3. **Smart-ID** (provided by the private sector company) (Riigi Infosüsteemi Amet, 2024).

Within Estonian eID ecosystem, RIA provides cross-border and national authentication services that institutions can use while providing their e-services. The state authentication service TARA (Trusted Authentication and Recognition Architecture) enables public and private sector organisations to authenticate their users of ID-cards, Smart-ID, Mobile-ID

as well as EU eID in their e-services (Information System Authority, 2024b). TARA supports cross-border eIDAS authentication, granting the existing structure for EUDI Wallet adoption.
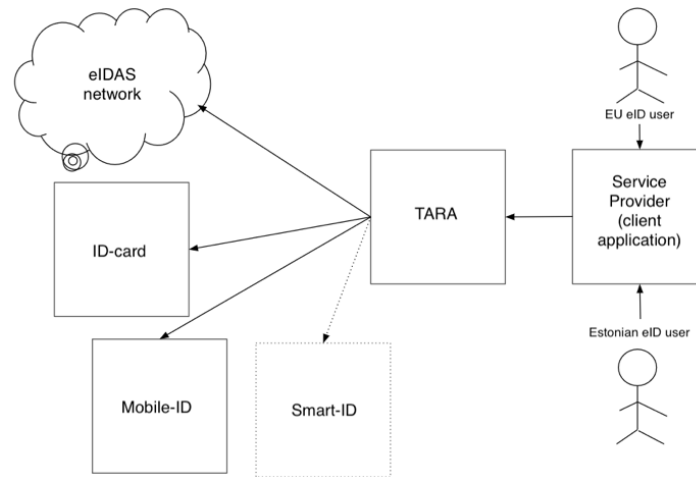


Figure 6. Schematic of Estonia's eID ecosystem and service delivery network.
Retrieved entirely from: Riigi Infosüsteemi Amet (2024)

On September 18, 2023, RIA introduced the State SSO (single-sign-on) service (GovSSO), which allows institutions to implement the authentication method for its users to log into an e-service with a single ID. GovSSO supports national authentication methods like ID-card, Mobile-ID and Smart-ID as well as EU eID schemes notified through the eIDAS-Node infrastructure (Information System Authority, 2024b). By providing the compatibility with eIDAS-Node, the capability of GovSSO to allow cross-border authentication aligns with the prospect of EUDI Wallet integration to the Estonian eID ecosystem. Estonia has managed to use the highest number of pre-notified eID schemes among the EU member states, which indicates country's ecosystem's versatility regarding implementing different eID means across borders (European Commission, 2024c).

### 6.1.1 EUDI Wallet and SDG in Estonian eID ecosystem

In Estonia, there are ongoing preparations for the EUDI Wallet's adaption. The development of the EUDI Wallet is currently coordinated by the Estonian State Information System Authority (RIA). The establishment of Estonia's digital wallet is based on existing eID solutions and recognised across Europe. The EUDI Wallet complements, but does not replace, the existing national eID solutions by offering cross-

border capabilities that allow users to verify their identity, share electronic documents, and access services (Information System Authority, 2024a).

Scheduled for adoption across Europe in 2026, the EUDI Wallet aims to expand the usability of digital services across borders in its development phase, RIA's contractual partner, AS Cybernetica, has conducted an analysis of the technical structure of Estonia's upcoming digital identity wallet to ensure its compatibility with the established electronic identity ecosystem (Vihma, 2024). Preliminary analyses have been conducted on various certificates, including a mobile driving license, which could be issued and utilised within the wallet (Information System Authority, 2024a).

As indicated in the previous texts, the EC has launched four LSPs for testing the EUDI Wallet use-cases with the member states' experts. Out of the four large scale pilot projects supported by the EC, Estonia is involved in one, a pilot project called POTENTIAL (European Commission, 2023e). Coordinated by RIA, the Estonian representatives participate in testing the cross-border functionality of the wallet in the context of mobile driving license (Information System Authority, 2024a).

The SDG in Estonia is coordinated by RIA. It is responsible for developing and managing technical solutions that support the SDG, including ensuring the availability of information from the state portal eesti.ee, and implementing analytics and feedback systems. This setup allows for the ongoing improvement of services and compliance with EU-wide standards, enhancing user experience and satisfaction across member states (Information System Authority, 2024).

Meanwhile OOP is one of the main principles of SDG, it is also one of the key values the Estonian digital government has followed from the beginning. On the level of Estonian governmental institutions, SDG is currently serving its purpose in different administration areas throughout 7 ministries (Ministry of Economic Affairs and Communications, Ministry of Internal Affairs, Ministry of Social Affairs, Ministry of Education and Research, Ministry of Finance, Ministry of Justice (background service) and Ministry of Rural Affairs) (*Ibid.*).

There have been governmental large-scale initiatives that include increasing the quality of public services among the citizens and entrepreneurs. A framework agreement for that purpose was established in 2022 by the Ministry of Economic Affairs and Communications. This development entails pilot projects, prototypes, analysing SDG (and OOP), the real economy (RTE), Eesti.ee entrepreneurs' digital gate and life event services (Ministry of Economic Affairs and Communications, 2022).

Based on the current eID ecosystem in Estonia, it is evident that the country is familiar with different electronic authentication methods, paving the way for the implementation of a new, cross-border service provision method. Bhattarai et al. (2019) emphasise that while Estonia's existing eID ecosystem functions effectively, it is crucial for other member states to have a functioning ecosystem, where the usability of SDG would show.

# 7 Research results

The following chapter showcases the conducted research results in three thematic parts: EUDI Wallet implementation in the EU, in Estonia and the EUDI Wallet's and SDG's alignment with one another. A thorough analysis is provided alongside the main outcomes and important findings. The analysis lays the groundwork for policy recommendations and suggestions for future research related to this domain. All of the interview questionnaires are in the appendixes of this thesis.

## 7.1 EUDI Wallet's implementation in the EU

The interviewees were asked to elaborate on the current status of EUDI Wallet's development and provide detailed insights into the progress. Within the interviews, experts discussed the advancements made so far and to describe the collaborative efforts that are shaping the EUDI Wallet.

### 7.1.1 Current state of play

Interviewees had a discussion on the EUDI Wallet's current developments, which at the time of the interviews was still in an ongoing process regarding the eIDAS 2.0 adoption. One of the main changes highlighted by one expert is that the EUDI Wallet will facilitate the adoption of eID means in EU member states, supported in the new eIDAS regulation. One interviewee emphasised: "*For eIDAS 1.0, there was a lack of let's say, interest energy within member states to provide the electronic notified identification mean, and also if they notify the ID mean, they need the peer-to-peer review. Now the wallet will be a regulation by itself and an eID mean. This will be facilitating the adoption of the usage and also the obtaining the eID mean for the member state. This will be one part. And for the cross-border, it is foreseen that the EUDI Wallet will be a container for attestations.*" Holding attestations will be simplifying both the issuance and widespread acceptance of electronic attestations related to various services, thus smoothing cross-border procedures without the need to be officially recognised, as highlighted by the interviewee. Another expert said that the EUDI Wallet as a new eID mean will help to overcome previous challenges such as lack of engagement and interest from certain member states in

adopting notified electronic identification methods, promoting a more cohesive regulatory approach.

European interviewees recognised that the EUDI Wallet is not just a digital repository for official documents but a tool with broad implications for simplifying a range of everyday activities. One interviewee's perspective focused on the practicality of the wallet in everyday scenarios. An example of identity verification through user's PID (Personal Identification Data) in the EUDI Wallet was given, which plays a central role in services like banking under PSD2 directive (*Directive (EU) 2015/2366*, 2015). Another expert elaborated on credential recognition complexity by bringing examples on educational qualifications like diplomas. It was emphasised how diplomas are categorised (e.g., PhD, MA, BA, high school diplomas) and how these categorisations are recognised differently across countries, requiring a process of equivalence assessment to determine the value and acceptance of a diploma. In addition to that, diplomas are credentials that are largely based on social agreements that define their validity, which can differ significantly across member states. One interviewee brought out: "*It's something that is the most complex aspect, because what constitutes a credential is like a social agreement. When you graduate from your university, you will get a credential that says that you graduated. There are some conditions to be met for it to be recognised. It may not be recognised in some other context.*" Moreover, mobile driving license was also another scenario brought out as an example of a notable credential integrated into the wallet. An interviewee underlined how its transition not only modernises how driving licenses are issued and carried but also aligns with the broader goals of enhancing digital integration and accessibility across the EU.

### 7.1.2 Challenges and risks

From the perspectives shared by the EC experts, various challenges and risks were identified in the EUDI Wallet integration process. One of the interviewees highlighted that while the EUDI Wallet will be mandatory for the member states to make available, the primary barriers to its successful integration include technological complexity and concerns over privacy. These issues are crucial as they directly impact user trust and willingness to adopt the wallet. Another interviewee noted that despite its mandatory status, there is a risk that the wallet might not be universally requested or accepted if users perceive it as insecure or invasive. Additionally, within the wallet there is a categorisation

of qualified, non-qualified, and public institution issued attestations. This reveals a nuanced challenge, where the cost and benefit of becoming a qualified issuer, especially for private entities like fitness clubs or employers, may discourage their partaking, likely leading to a dominance of non-qualified attestations.

The other expert brought up the matter of interoperability across the EU, namely its semantic, operational, legal, and technical challenges. As also highlighted previously, the expert pointed out that even with standardised terms like diplomas or driving licenses, varying national regulations and standards can lead to different interpretations, complicating the credential exchange process. For instance, the recognition of driving licenses as valid ID documents varies by country, and some are dependent of health conditions, which are not universally applied. One of the interviewees emphasised: *"Some driving licenses are bound to health certificates, so when you are no longer healthy to drive or well enough to drive, then you cannot anymore drive, even if you are skilled or have the knowledge. For other driving licenses this is not the factor. The driving license is still valid even though you don't have the physical or mental capability."* Such lack of standardisation can delay the seamless cross-border use of such credentials.

Both experts acknowledge the potential for limited use-cases for the EUDI Wallet, with certain credentials having more obvious cross-border applicability than others. *"We have kind of two avenues here. We have credentials that are kind of legally driven like driving license like the identity, travel credential, e-prescription and like some other examples. And then you have more market-driven like loyalty cards… or let's say that are not so relevant,"* was outlined by one of the experts. One interviewee had concerns about the adoption and trust in the wallet, especially in contexts like banking where identity verification is crucial, highlight the risk of liability issues in cases of identity fraud. The interviewee underlined: *"Banks are, I think, today the ones that are really concerned about the authentication of citizens and if they will trust in the EUDI Wallet. If there is authentic identity fraud, who is going to be liable for this? The wallet, the bank? So, I see a problem here."* Meanwhile, the other expert emphasised the cultural and systemic differences in eID usage across member states, which could affect the uptake and effectiveness of the wallet.

### 7.1.3 Data privacy and security

The EC has been proactive in addressing data privacy and security concerns related to the implementation of the EUDI Wallet, as outlined by the EC experts. One of the experts addressed data privacy and security concerns for the wallet by implementing regulatory and technical framework. The expert explained that the ENISA (European Union Agency for Cybersecurity), under the Cybersecurity Act (*Regulation (EU) 2019/881*, 2019), has been mandated to develop security profiles or cybersecurity schemes specifically tailored for various ICT products and services. The expert emphasised the need for a comprehensive cybersecurity scheme that covers not just the wallet as a product but also as a service. It was mentioned that the wallet requires additional security measures that may be outlined in further ENISA documentation or under the EBSI (European Blockchain Services Infrastructure) guidelines.

The other interviewee validated the significance of privacy in the development of the EUDI Wallet and also noted that it is a politically sensitive area, which is analysed by stakeholders who are keen to ensure that privacy is protected. It was highlighted that the involvement of these stakeholders, who are cautious about upholding privacy standards, plays a crucial role in guiding the EC's policies and practices.

### 7.1.4 Legal framework and stakeholder engagement

Besides eIDAS 2.0, the interviewees elaborated on the integration of other legal and regulatory frameworks that the EUDI Wallet is potentially influenced by. Both interviewees pointed out the OOTS/SDG to lay the ground for existing data exchange layers or practices. One interviewee stated that the integration of the EUDI Wallet entails the context of different European regulations such as the GDPR (*Regulation (EU) 2016/679*, 2016). Moreover, there are cybersecurity schemes, both at the European and national levels, which ensure that the wallet adheres to the highest standards of digital security, as highlighted by the interviewee.

Both experts emphasised that as the EUDI Wallet is entering the market as a new tool, it also enters a landscape filled with existing data exchange standards and practices. This means that data exchanges tailored to specific sectors, such as those in healthcare, aviation, and payment services (like Apple Pay and Google Pay), have their own technical, organisational, and legal infrastructures. Additionally, data spaces in the EU

have to align with Data Governance Act (*Regulation (EU) 2022/868*, 2022) and Data Act (*Regulation (EU) 2023/2854*, 2023). Therefore, the wallet must be compatible with diverse systems, each governed by its own set of international standards and practices, as highlighted by the experts.

For stakeholder engagement, the experts emphasised the EC's steps from directly working with EU member states' representatives through the EUDI Toolbox to managing the EUDI platform to gather insights from stakeholders and the industry. One expert covered the establishment of the expert group to work on LSPs and facilitate sprints for addressing the main issues before the EUDI Wallet launch. One interviewee also brought out EBSI (European Blockchain Services Infrastructure) as one possible pilot project in addition to LSPs. The use of platforms like GitHub and the agile methodology are central to the process. Moreover, one of the experts underscored that the EC maintains close contact within its divisions (such as DG MOVE, DG HOME, and DG JUST) and with external stakeholders, including industry associations and lobby groups.

A noteworthy circumstance emerged from the EC experts' interviews - the EC does not have specific key performance indicators set for the EUDI Wallet. As highlighted by one of the experts, the Commission's operations are primarily political and revolve around negotiations between institutions, legislative mandates and set deadlines. While there is a structure for reporting and data collection, traditional targets like user numbers are not standard for measuring success, given the interviewees' answers.

## 7.2 EUDI Wallet's implementation in Estonia

Interviews entailed tailored questions for creating an understanding of Estonian eID infrastructure as well as its current compatibility with the EUDI Wallet as well as the cross-border service delivery future in Estonia. Additionally, the interviews covered current usage of SDG in Estonian eID ecosystem. Interviewees were selected based on purposeful sampling, whereas two separate sets of questions were made for Estonian experts and Estonian public-private sector stakeholders, which were also cross-analysed.

### 7.2.1 Integration into Estonia's digital landscape

The interviewees gave a thorough overview about Estonian eID ecosystem and its readiness regarding the EUDI Wallet. All the experts had a unanimous opinion that as

Estonia has a robust electronic digital identity system already in place, the EUDI Wallet's integration will be treated as an additional eID mean. One interviewee brought out: "*Particularly about the EUDI Wallet, Estonia has a very unique situation because our current electronic identity works very well. And in many ways, we have to find the reasons why we need a wallet internally in addition to international and cross-border operations.*" Wallet's integration has to be well justified, even though it is expected to be a relatively simple process due to the existing digital infrastructure. Interviews indicated that the experts see the EUDI Wallet as an enhancement rather than a necessity, with a possibility to integrate with the EU's cross-border service provision in a way that has not been used in the ecosystem before. One interviewee pointed out that since Estonia already has three widely used eID means, the EUDI Wallet is not filling a gap but adding functionalities like secure evidence transfer from one institution to another via device binding for privacy protection as well as Wallet's capability for presenting evidence in face-to-face interactions. "*Wallet adds functionality, but for functionality, we don't have all that Wallet functionality to carry evidence or attestations from one institution to another through some secure use of user connected device. Of course, we are used to electronically signed and sealed documents and we can carry them from one institution to another also using memory sticks or e-mail or so, but Wallet offers device bindings,*" was outlined by one interviewee.

Interviewees brought out that the EUDI Wallet integration in Estonia requires a clear, defined division of roles at the government level. It was pointed out that this division can be very politically dependant and a lot of rules and obligations are coming from the new eIDAS. In general, Estonian experts see two main institutions as central – Ministry of Economic Affairs and Communications and RIA (Estonian Information System Authority). These institutions are strongly involved in the EUDI Wallet's development processes, ensuring Estonian eID ecosystem's compliance with that. However, some limitations were also highlighted in terms of privacy by one interviewee: "*If somebody acts as proxy for relying parties - single point of identification, authentication - then this proxy can't collect and have knowledge about those transactions. The idea that RIA will collect information about transactions, is actually a problem. Maybe TARA or Single Sign-On solution should be run in the future by some other institution who is not collecting and having information about those transactions.*" Moreover, Estonian Ministry of Interior is brought out as an institution overseeing security-related aspects of

the EUDI Wallet's implementation. One interviewee brings out the necessary collaboration of the Police and Border Guard Authority as well as the IT Service for the Ministry of Interior.

Interviewees emphasised that one of Estonia's main preconditions for integrating the EUDI Wallet is not the establishment of the eID infrastructure, which is already in place, but rather addressing the legal challenges, ensuring technical compliance, and managing the user experience and uptake future challenges associated with the wallet. Therefore, the primary challenge lies in the technical realisation of the wallet itself.

### 7.2.2 Barriers and uncertainties

Interviewees pointed out that one general challenge in Estonia is to be ready for the new requirements that derive from eIDAS 2.0. One of the interviewees emphasised that the eIDAS regulation's existing roles and responsibilities will provide sufficient legal infrastructure without needing a new legislation. This means that since eIDAS regulation is directly applicable and not subject to rewriting into Estonian law, the focus will be on making specific and necessary legal adjustments. Another interviewee emphasised that it is necessary to compare the changes between eIDAS 1.0 and 2.0 to recognise the new roles and responsibilities, which must be incorporated into national legislation as a fundamental step towards implementing the EUDI Wallet in Estonia. Based on this, the interviewee discussed that the future might involve reviewing the Electronic Identification and Trust Services for Electronic Transactions Act (Riigi Teataja, 2016) to incorporate these roles within the national legal context.

A significant barrier highlighted by one interviewee is the certification of the EUDI Wallet. There is currently a lack of agreed standards and methodologies for certification schemes, creating uncertainty. It was mentioned by one of the interviewees that certification is a particularly pressing issue for Estonia as it does not possess its own certification bodies, relying instead on other countries. This concern was complemented by the fact that while there was hope to leverage European certification schemes under the Cybersecurity Act, there seems to be a delay or absence in finalising such certification schemes. One Estonian expert pointed out their concern by saying that in case there are no standard solutions in place once the wallets enter the market, it is questionable whether the private sector could afford ensuring the validity of these. The expert said: "*I think that*

*is something to really ensure in these like policy recommendations as well that the standardisation is very important and certification as well. We have seen it once in terms of this PSD2 and open banking where regulators say that there is a need to follow common standards and then everybody followed sort of common standards or like a different set of standards but still even inside one country every bank is a little bit different."*

A few experts brought out the risk of uncertainty around identity matching of the Wallet's approach to eID. *"I think one of the major risks might not be EUDI Wallet specific in general, but if we talk about e-identity, then we have to talk about record matching. So not only the identification will give me the knowledge who this person is,"* as brought out by one expert. This underscores the crucial need for mechanisms that not only authenticate identity but also accurately associate the correct data with the right individuals, thus safeguarding the integrity of the entire system.

A key concern emphasised by some interviewees was the secure storage of cryptographic keys within the EUDI Wallet. The challenge lies in protecting this sensitive material from unauthorised access, a problem that extends across Europe. Estonia's current identification solutions have secure private keys within chips or SIM-cards, but for the EUDI Wallet, a solution that works across various smartphone technologies is required. A cloud-based or secure server-side solution similar to Estonia's Smart-ID is proposed by one interviewee, which could also enable broader access to the EUDI Wallet.

### 7.2.3 Potential use-cases in Estonia

The interviewees outline several potential use-cases for the EUDI Wallet in Estonia, focusing on both cross-border and domestic applications. The mobile driving license emerges as a critical use-case outlined by most of the interviewees, whereas they express that Wallet's capability to provide proof of the right to drive and age verification electronically could be very beneficial for Estonia. This functionality would be a significant advancement over current practices, such as submitting a photo of one's driving license to a rideshare application. One of the most important enhancements brought out by an interviewee is the EUDI Wallet's ability to offer selective attribute sharing, such as age confirmation without disclosing full identity details. However, there are concerns revolving around the security and trust issues.

A few experts outlined strong opinions on the constant validity of the driving license. One privacy concern regarding the mobile driving license was strongly highlighted by a few experts: a blacklist system. The wallet user might find themselves in a situation where it is not possible to fully prove their electronic attestations due to the planned blacklist system. Interviewees were pointing out the impracticality of a blacklist system that would track invalidated digital wallet numbers. Instead, there could be a solution that balances the need for up-to-date verification with privacy protection. One interviewee brought out: *"And then again, in other countries, we have the experience of how to approach these empty lists, so that we can know that this driving licence, that you can identify the validity of this mobile driving licence by its expiry date. It has a start of validity and an end of validity. That is okay, but now the rights that come with this driving licence, we have separate driving rights, but if my medical certificate expires, for example, then my driving rights are suspended, so how do you find that out? And you need online enquiries for that."* Instead of maintaining extensive blacklists of invalidated credentials, which would also have to be updated regularly and could become unmanageable, there was a suggestion of an online query system that operates within a defined timeframe. This system could maintain individual privacy by concealing the details of who is making the inquiry and from where, while still providing the needed information.

For the banking sector, the EUDI Wallet could facilitate secure authentication while logging into the digital banking services. In addition to that, one of the interviewees emphasised managing the payments e.g., using the wallet in payments confirmation flow. By having all electronic attestations of credentials in one place, direct sharing of information with the banks will be also simplified for users. One expert underlined that the Estonian banking sector does not have a lot of practice regarding requesting users to provide a lot of documents about their background, e.g., credit ratings. These might come along in the future, but most probably will not be prevailing. Additionally, as outlined previously in the analysis, banks could have a significant impact on the adoption of the EUDI Wallet, which will be a convenient eID mean for the user to access their bank account.

One interviewee outlined the EUDI Wallet benefit from the perspective of Estonian-Finnish economic activity. For Estonians working in Finland or for Finnish residents in Estonia, the wallet could potentially ease the process of logging into services or presenting proof of information related to pension funds, tax payments, or health

information. This indicates the already existing linkage between two countries' interoperability in terms of data sharing.

In general, the interviewees suggest that the domestic ecosystem is already robust with established identity systems and facilitated data exchange via X-Road. It is evident that in Estonia, the EUDI Wallet's value may lie more in its ability to simplify and streamline existing processes rather than introduce entirely new functionalities.

### 7.2.4 Adoption and collaboration

The interviewees collectively described that the private sector appears both intrigued by the potential of the EUDI Wallet and cautious due to the current state of uncertainty. One of the interviewees had a vision for the EUDI Wallet as a multi-purpose platform, not limited to government services but extended to private sector services like cinema tickets and customer loyalty programs.

Another expert touched on the fact that certain industries, like finance, energy, and transport, might not have much choice but to get on board with the EUDI Wallet due to new rules from eIDAS 2.0. However, it emerged from the interviews that Estonia's private sector representatives are showing active interest and willingness to understand the wallet's future. One expert mentioned banks' interest in testing and exploring new service improvements as soon as workable solutions become available, as well as the enthusiasm of an Estonian ridesharing business.

Conversely, there was an outlook highlighted that the private sector may view the EUDI Wallet as a regulatory necessity rather than an option. However, sectors with high usage of eID means like banking sector, could significantly boost the adoption of the EUDI Wallet by preferring as one of electronic authentication ways, as emphasised by one expert. It was suggested that if European banks adopted the wallet widely, they could motivate their customers to use it: *"If banks are pushing to use a wallet instead of these member states dependent eID needs, then maybe this initiative from banks can influence wider public to overcome to the Wallet."*.

When the author asked interviewees about Estonian public's response to the EUDI Wallet and specific strategies for user adoption and trust, they acknowledged that this is one aspect where Estonia is still lagging behind, without any specific activities at all. In one

interview, it was pointed out that it is not even a concern about only getting the citizens' opinions, but also interacting with the majority of sectors that are involved with online service provision. One expert pointed out that this might be also the case of an already well-functioning system in Estonia.

Talking about the EUDI Wallet adoption by the larger audience, the significance of user experience and friendliness was emphasised in the interviews. One of the experts particularly emphasises the importance of the wallet's user-centric design, which would allow citizens to control and be responsible for their personal data, making this very impactful.

In terms of public-private partnerships, Estonian public sector representatives are consulting local companies (e.g., Cybernetica and SK ID Solutions) and certain stakeholders like ITL (Estonian Association of Information Technology and Telecommunications), who provide valuable insights within their expertise related to digital service provision. However, one of the experts highlighted as the solution is not in force yet and the regulation still underway of being fully in force, it is still early for predictions. For instance, an expert underpinned that since the private sector is strongly focused on optimisation and monetary value proposition, the level of adoption is highly dependent on the wallet providers' costs for their services.

One of the interviewees brought out that process for relying parties to register with the government to use the wallet for authentication purposes should be straightforward and not intimidating. The interviewee emphasised the fact that whereas currently Estonian companies can easily integrate identity authentication method in their service provision, it cannot be done the same way with the Wallet, which requires registering in the government registry at first. Simplifying this process would help along the successful adoption of the EUDI Wallet.

Experts indicate in the interviews that Estonian cooperation involves active participation in different EU coordination groups, related with eID, EUDI Wallet, OOTS, etc. The government keeps stakeholders informed through briefings and relies on direct information from a national expert in the EC. However, most interviewees stress that Estonia has regrettably low capacity to be well represented in dedicated committees and working groups to contribute fully with the national expertise.

### 7.2.5 Estonia's eID ecosystem future after eIDAS 2.0

In general, the experts express their general curiosity towards the EUDI Wallet developments in Estonia. It is evident that Estonia is preparing well for the integration of the EUDI Wallet within its national digital identity framework. The discussions among stakeholders reveal a hope for positive changes, especially concerning the undetermined future of Mobile-ID as the country adapts to the requirements of eIDAS 2.0. It emerged from a few interviews that experts believe Mobile-ID to phase out after the eIDAS 2.0 has come into force, with expectations indicating possible change in Estonia's digital identity means. One expert emphasised that this would be an additional push to not continue with Mobile-ID due to its outdated technology. One interviewee emphasised: *"If the Mobile-ID status cannot be renewed after 2027, then there is a need to have another new technical mean, which means that there are definitely necessary changes how this mean will be provided. But the issues are, which are for now, already very visible."* Given that the renewal of Mobile-ID's status after 2027 is under scrutiny, there is a need for an alternative technical mean. For that, proactive discussions occurring within ministries and agencies are taking place.

## 7.3 EUDI Wallet and SDG

In the interviews, both European and Estonian experts were asked to elaborate on the SDG's alignment with the EUDI Wallet and whether these means have any similar or unique features. The experts' opinions were different depending on their approach to the features. In general, it was mentioned that the EUDI Wallet and SDG exhibit distinct functionalities and features, but they pose common components. One European expert underlined: *"Identification and signature are two features that are specific to Wallets or eID means or qualified electronic signature services that are not in the scope of SDG."* European experts recognise the synergy between the two in facilitating data exchange and authentication processes. It was brought out by one expert: *"SDG mechanism and common components can be useful also for other Wallet usages to get right attestations to the Wallet. But I have a suspicion that there's needed some legal adjustments in regulations related to SDG or Once-Only Technical System implementing act."* Regarding the OOTS, a few experts highlighted the synergies between this and eIDAS, whereas one expert mentioned: *"Basically OOTS will never establish their own*

*authentication or signature features, it will use the features that eIDAS is providing. In that matter, the OOTS is relying on eIDAS."*

Moreover, the EUDI Wallet's focus is on the government-to-citizen (G2C) interface, enhancing individual user control over data sharing and authentication. In contrast, SDG typically handles government-to-government (G2G) exchanges. *"The EUDI Wallet can facilitate the issuance the authentication of the citizen against these, the public bodies, as far as you know, SDG works only for the public administration for the public sector."* One of the experts pointed out that as SDGR's capabilities are confined to the public sector, the EUDI Wallet could vastly improve interactions within the private sector (B2B), where SDGR is not applicable. This indicates that the EUDI Wallet could potentially bridge the gap between public and private sector data exchanges.

It was highlighted by one of the experts that while SDG and the EUDI Wallet both allow for the user-initiated retrieval of data, SDG doesn't permit mass queries, thus presenting similar data exchange patterns. SDG features mandatory responses for specific services, making its use obligatory for those services, whereas the EUDI Wallet, though technically capable, remains optional.

In general, interviewees noted unique features of the EUDI Wallet, such as the ability to produce qualified signatures and seals and its facilitation of credential issuance, which are not within the scope of SDG. These features provide distinct advantages to the EUDI Wallet in terms of legal identity verification and document authentication.

### 7.3.1 EUDI Wallet's synergy with SDG in Estonia

It emerged from the interviews that from the country's perspective, both the EUDI Wallet and SDG are more beneficial for cross-border actions than for domestic use. For instance, it was brought out by Estonian public and private sector representatives that so far, SDG has not had any significant impact on their service provision.

The interviews revealed that the technical teams responsible for Estonia's eID ecosystem and SDG functions with a degree of autonomy, with a likelihood of working in silos. One of the interviewees pointed out that there is currently not too regular cooperation between the technical teams for the EUDI Wallet and the SDG due to differing technical challenges. Despite this, a strategic agreement is forming at RIA, which suggests a

potential integration path where both the Wallet and the SDG will ultimately cooperate. However, from the Estonian experts' current standpoint, the SDG and the EUDI Wallet do not have operational synergies in place, yet their future cooperation is planned.

From Estonian experts' point of view, the SDG and EUDI Wallet in Estonia are still in separate lanes. Nevertheless, there is a clear intention to treat those initiatives as means that complement one another for better cross-border digital service provision. Estonian experts brought up the need for addressing current challenges, including identity matching and privacy protection, which would need to be considered for the EUDI Wallet integration into the existing digital infrastructure.

As previously emphasised, a challenge shared by both systems is identity matching, a critical function that ensures a person in one member state is recognised across all others. The interviewees have expressed that this remains a problem for both the SDG and the EUDI Wallet. One interviewee mentioned: *"... Also a huge problem is identity matching to understand that some record in databases or in one country about the same person who is registered in another country using a different ID code or different attributes for identity matching. There were hopes that SDG will somehow solve it. Didn't solve it so... There were hopes that there will be new eIDAS and comes wallet and solves that problem. It's a common problem. Similar features don't solve this problem. And this problem is for both cases, it's a problem for SDG and a problem for Wallet."* While hopes were pinned on these systems to resolve this issue, the expectations have not yet been met, demonstrating a critical area for future development.

### 7.3.2 Alignment of the EUDI Wallet and SDG

Based on the input provided by European and Estonian digital identity experts, the table below provides a comparative overview of the EUDI Wallet's and SDG's features, analysing their alignment and providing explanatory remarks.

Table 3. Features of the EUDI Wallet and SDG.

| Feature | EUDI Wallet | SDG | Features alignment (Yes/No) | Remarks |
|---|---|---|---|---|
| **Adaptability to various use-cases** | More flexible, supports both public and private sector exchanges | Focus on mandatory public services, not directly meant for private sector | Yes | Alignment only regarding the digital public service provision. EUDI Wallet can be integrated with use-cases across sectors, whereas SDG is more focused on strictly G2G use-cases for mandatory life services. This has a potential of affecting systems' integration across sectors. |
| **Authentication** | Has its own authentication mechanisms, can operate independently | Uses eIDAS-based processes for authentication | Yes | Authentication is a component of both systems, but through different mechanisms. Has a potential for synergy in unified authentication processes. |
| **Credential issuance** | Can store credentials issued from service portals | Does not have a direct mechanism for issuing credentials | No | EUDI Wallet's ability to store credentials complements SDG's data services, potentially enhancing user experience. |
| **Data exchange** | Authenticates and permits data sharing between administrations (G2C and citizen-to-wallet) | Provides data through a centralised portal (Your Europe), data sharing designed for G2G interactions | Yes | Both platforms facilitate data sharing, but with different focal points. SDG has a main focus on assisting users in information discovery, EUDI Wallet is more about giving users access and control over their data. |
| **Real-time data queries** | Supports real-time queries, fits well with dynamic and user-driven interactions | Does not support real-time queries because of the preview requirement. It is | No | EUDI Wallet's capability for real-time interaction contrasts with SDG's batch-oriented data handling. |

| | | oriented towards batch processing. | | |
|---|---|---|---|---|
| **Legal framework** | More flexible, operates under the eIDAS regulation, which is less prescriptive and broader framework | Operates under a specific regulatory framework (SDGR), which has defined mandatory services. SDGR is also aligned with eIDAS regulation. | No | EUDI Wallet benefits from a broader and more adaptable eIDAS regulation, allowing wider applicability across sectors. SDGR is more focused and constrained with specified mandatory services. |
| **Privacy** | User control and privacy matters as one of the most important and critical features | User control and individual privacy are not so focal | No | Differences in privacy approaches, posing a challenge in systems' interoperability. |

Based on the experts' input, it is evident that EUDI Wallet and SDGR align in some areas but remain distinctly different in others, particularly in terms of data handling, privacy measures, and operational frameworks. These distinctions could serve as focal points for future discussions on potential integrations or modifications needed to enhance their synergies within the EU digital ecosystem.

# 8 Discussion

This research used a qualitative methodology with a case study approach to formulate answers to the research questions. Based on the extensive analysis conducted on the implementation and integration of the EUDI Wallet in the context of eIDAS 2.0 as well as finding synergies between SDG, policy recommendations are given in this chapter. This research started with conducting the literature review and analysing the secondary data to understand the scope of this study. Based on that analysis, answers to the first main research question "How does the integration of the EU Digital Wallet into cross-border service provision processes relate with the implementation of the Single Digital Gateway?". Sub-questions helped to support the main research question by covering different important aspects.

This research had an aim to discover the integration of EUDI Wallet into cross-border provision processes within the EU. Cross-border service delivery is primarily governed by the eIDAS regulation, which has been recently adapted to its 2.0 version, mainly to accommodate the EUDI Wallet. This regulation establishes a framework for electronic identification and trust services, providing a legal basis for cross-border digital interactions. Additionally, SDGR legally complements eIDAS in the cross-border service provision by having provided a groundwork for accessing public services across the EU.

The integration of the EUDI Wallet with the SDG represents a complex interplay of technological, operational and legal barriers. The author identified the following barriers:

1. **Technological complexity and interoperability**: the integration faces significant challenges due to the diverse technological infrastructures across EU member states. The EUDI Wallet's advanced features, such as real-time data queries and the ability to handle a variety of digital credentials, should be aligned with the more static data handling of the SDG. Moreover, there are issues related to the interoperability of existing national eID systems with the EUDI Wallet, especially since the wallet introduces new requirements for electronic identification.

2. **Privacy**: the EUDI Wallet prioritises user control over personal data, aiming to empower users to manage their digital identities actively. In contrast, the SDG's focus is less centred on individual privacy.

3. **Different legal frameworks**: the EUDI Wallet operates under the broad, less prescriptive eIDAS 2.0 regulation, which allows for greater flexibility and adaptability. On the other hand, the SDG is bound by more specific mandates that limit its scope primarily to public services and government-to-government interactions.

To streamline the service provision of both EUDI Wallet and SDG, policy-makers have done the mapping of the eIDAS 2.0 Regulation and OOTS, derived from SDGR. The OOTS under the SDGR minimises redundant data submissions, which support the EUDI Wallet in administrative processes.

The EUDI Wallet is designed to be flexible, supporting a broad range of both public and private sector interactions, and empowers users with control over their digital identities. In contrast, the SDG is designed primarily for mandatory public services and operates under stricter regulatory constraints. While the EUDI Wallet and the SDG share a foundational goal of simplifying and enhancing digital interactions across Europe, their operational and functional features (visible in *Table 3*) differ considerably. Their connecting parallel is OOP, which is a supporting principle of both eIDAS and SDGR. Thus, while SDG is already in use among different institutions in the EU, it is necessary to define the synergies between two provision means to avoid complications in understanding their purposes and foster interoperability.

The second main research question addresses the implications of the EUDI Wallet implementation in Estonia. The findings related to this question are based on secondary data and the analysis of semi-structured expert interviews. The new eIDAS 2.0 implementation sets an obligation for the member states to prepare for the upcoming EUDI Wallet. It emerged that as Estonia's eID ecosystem is rather mature, it is still facing challenges with implementing a new electronic identification mean. Challenges include

standardisation, identity matching, clear division of roles and responsibilities and other aspects, which could be addressed in other EU member states as well.

In contrary, these challenges are met with important opportunities. The digital wallet can significantly enhance the efficiency of service delivery, reducing costs and bureaucratic overhead. It offers a streamlined approach to accessing a wide range of services for Estonian or EU citizens at home and abroad.

## 8.1 Policy recommendations

The author highlights recommendations, which could be applied in the EUDI Wallet implementation processes in the EU member states. These recommendations are based on the research background and interview results:

- There is a need for larger attention towards standardisation across the EU for cross-border credentials' recognition. There should be a standardised understanding of credentials. For instance, attributes of mobile driving licenses as well as educational and professional certificates differ across the EU.

- It should be clearly communicated with set standards on how different Wallet providers have built up the product and comply with the requirements from public and private sector institutions across countries, and vice versa. Though the importance of developing standardised user interfaces for the EUDI Wallet to simplify user interaction and enhance experience across platforms is also stated in the objectives of LSPs (European Commission, 2024e), this should be still strongly emphasised.

- As the EUDI Wallet will have a significant influence across Europe, encouraging collaboration between government, academia, and the private sector could be beneficial to leverage expertise, meet the needs of stakeholders and enhance technology in implementing the EUDI Wallet.

- It is necessary to create an understanding for the EU member states about how the new technical requirements deriving from the EUDI Wallet relate with the functionality and interoperability of eIDAS-Nodes. If the EUDI Wallet loses the

necessity of using eIDAS-Nodes within wallet provision, then it will be up to member states to decide the future maintenance of nodes.

- Setting clear roles for local authorities, national governments, and EU bodies is essential in the implementation process of the EUDI Wallet to streamline efforts and avoid duplication of resources. This is also important to understand the responsibility of the authority that is going to carry the costs or is held liable for the Wallet in case of complications.

- There should be training and ongoing support for the involved stakeholders arranged to ensure they are equipped with the necessary skills and knowledge regarding the EUDI Wallet implementation. This is important to note regarding the institutions that are currently using SDG, meaning that they will need to have an understanding on the difference and/or alignment of both online service provision methods.

- In the future, some key performance indicators should be set for monitoring and evaluating the performance of the EU Digital Wallet and the SDG to ensure both are meeting their intended goals.

- Provision of incentives for businesses and public agencies is important to influence the adoption and integration of the EUDI Wallet into their digital infrastructure. It is necessary to understand, what kind of costs are set by the Wallet providers to prevent the resistance of potential service providers to use the wallet solution.

- Clear protocols or synergies could be established for data portability between the EUDI Wallet and SDG, relying on the OOP and ensuring seamless service provision.

- Implementing a systematic feedback mechanism for users of the EUDI Wallet could help to improve the wallet's functionalities based on user experiences and needs.

To conclude, the recommendations outlined above provide the groundwork for the structured implementation of the EUDI Wallet across EU member states. These recommendations emphasise the importance of collaboration, standardisation, and comprehensive stakeholder training to ensure the successful deployment and integration of the EUDI Wallet. By addressing these specific areas, policymakers can have a unified approach, which will be critical as the eIDAS 2.0 regulation will be enforced. This stance will facilitate smoother transition and adaptability across diverse eID ecosystems, enhancing the overall effectiveness of digital identity solutions within the EU.

# 9 Limitations and future work

This chapter outlines the limitations encountered in this study and suggests directions for future research. It examines the constraints specific to the EU and Estonian context and underlines how the research findings can support broader discussions and developments in the relevant field.

## 9.1 Limitations

This study faces different limitations from the perspective of subjectivity (not being able to conduct the research without previous knowledge or assumptions) and generalising the findings (case study has particular focus on Estonia) based on the chosen country for a case study. As Estonia is one of the most advanced EU countries in the field of digital identity, its case study results might not be as applicable in other countries that do not have as developed eID ecosystem.

Additionally, the interviews could not be extended to larger number of interviewees, as the circle of eID experts in Estonia is not large, and therefore was with limited essence. Furthermore, there occurred a slight lack of interest from the interviewees/stakeholders to elaborate on this research topic, as the EUDI Wallet is still viewed as a prototype and is not feasible. This also set limitations to the input from public and private sector representatives, who can discuss about the EUDI Wallet simply in theory.

Moreover, the research was affected by the legal restrictions. The ongoing amendment process of the eIDAS 2.0 that played an important role in the study and influenced its outcome, has its uncertainties as it has not gone duly into force and used in practice yet.

Despite these limitations, the insights derived from this focused approach provide valuable contributions to understanding the complexities and potential of eID systems in a new context. The findings are instrumental in illustrating best practices and challenges that can offer policy-makers ways to anticipate and mitigate potential barriers. Additionally, the unique position of Estonia as a frontrunner in digital identity provides a

perspective on the operationalisation of the EUDI Wallet, highlighting the significance of readiness and adaptability in the broader EU landscape.

## 9.2 Future research directions

Future research could look more thoroughly into the EUDI Wallet's user acceptance and adoption in the EU, which was only covered by theoretical framework in this research.

A comparative analysis of the digital identity frameworks across various EU countries could be potentially done, as eIDAS 2.0 is newly enforced. Further studies could identify best practices and challenges in the implementation of eIDAS 2.0, providing a deeper understanding of the new cross-border service delivery regulation. Moreover, the author sees that this could have a more specific focus on the wallets across member states and study their technical and operational differences, with a possible focus on standardisation. Additionally, future investigations could explore the certification scheme associated with the EUDI Wallet and compare how different EU member states are developing and integrating these schemes into their national frameworks.

# 10 Summary

This thesis explored the integration challenges and potential synergies between the EUDI Wallet and the SDG within the eIDAS 2.0 regulation. The study primarily analysed the EUDI Wallet and gave insights on how two systems align and diverge in their functionalities and legal frameworks, impacting their interoperability and effectiveness in facilitating cross-border digital services. The posed research questions focused on the integration of EUDI Wallet into existing cross-border service delivery in the EU and studied its alignment with the SDG.

This study gave a context of existing literature in this domain, focusing strongly on the context of eIDAS regulation. Theoretical framework with a focus on Koppenjan and Groenewegen's institutional design, Technology Acceptance Model and European Interoperability Framework helped to formulate the basis for EUDI Wallet's successful cross-border service delivery. A thorough document analysis gave insights into the operational and legislative nuances of the EUDI Wallet and SDG, underlining key areas for policy enhancement to support cross-border digital service integration. To give an understanding of how the EUDI Wallet influences the cross-border service delivery in the EU member state, this study had a particular focus on the Estonian eID ecosystem, which was analysed through semi-structured interviews with Estonian public and private sector experts. In addition to that, European high-level experts' opinions helped to analyse the EUDI Wallet's implementation on the EU level. A thematic analysis based on the experts input helped to recognise the EUDI Wallet's current state of play and create an understanding of its regulatory and technical requirements for EU member states' policy-makers.

To conclude, this master's thesis addressed the research questions along sub-questions in full. This research provides an overview of the EUDI Wallet implementation in its new regulatory context from the theoretical and practical standpoints, making the main contribution by providing a thorough analysis along policy recommendations for the EU and Estonian policy-makers in the field.

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# Appendix 1 – Interview questions for European experts

## Part I - European experts

<u>Planned duration:</u> Approx. 1 hour

<u>Interviewer:</u> Engel-Mari Mölder, E-Governance Technologies and Services MSc student

<u>Interviewee's country of residence:</u>

### Introduction
1. Please describe your current position and main responsibilities?
2. Please describe how are you related to the EUDI Wallet initiative?

### Main interview questions
3. What is the current status of the EUDI Wallet development in the context of digital identity?

4. How do you see the integration of the EUDI Wallet impacting the cross-border credential verification processes within the EU?

5. How does the current implementation of the Single Digital Gateway support and align with the future of the EUDI Wallet?
    a. Which features of SDGR align with the EUDI Wallet features?
    b. Are there any unique features that either SDGR or EUDI Wallet has that do not support one another?

6. From the perspective of the European Commission, what are the main barriers or challenges encountered in the integration of the EUDI Wallet (including in the context of Single Digital Gateway)?
    a. What could be some of the major risks of implementing EUDI Wallet?

7. How has the European Commission addressed concerns related to data privacy and security while proposing the EUDI Wallet?

8. What are the legal or regulatory considerations in addition to eiDAS 2.0 that impact the integration of the EUDI Wallet?

9. How does the European Commission collaborate with member states, businesses, and other stakeholders to address challenges and ensure a smooth integration process for the EUDI Wallet?

10. Which are some of the specific key performance indicators or metrics used to measure progress and impact while implementing the EUDI Wallet?

11. How does the European Commission ensure the successful implementation of the EUDI Wallet in the Member states?

12. How does the European Commission gather and incorporate feedback from the users and relevant stakeholders during the development and implementation of the EUDI Wallet?

13. In your opinion, what are the most critical use-cases of the EUDI Wallet?

14. Would you like to add something else regarding the topic that has not been discussed yet?

# Appendix 2 – Interview questions for Estonian experts

Planned duration: Approx. 1 hour

Interviewer: Engel-Mari Mölder, E-Governance Technologies and Services MSc student

Interviewee's country of residence:

**Introduction**

1. Please describe your current position and main responsibilities?
2. Please describe how are you related to the EUDI Wallet initiative?

**Main interview questions**

1. Can you provide an overview of Estonia's current digital identity landscape, particularly in the context of the EUDI Wallet?

2. From your perspective, how does the integration of the EUDI Wallet into (cross-border credential verification) processes align with the implementation of the Single Digital Gateway in Estonia?
   a. Which features of SDGR align with the EUDI Wallet features?
   b. Are there any unique features that either SDGR or EUDI Wallet has that don't support one another?

3. What are the key preconditions that Estonia needs to fulfil for the seamless integration of the EUDI Wallet into its eID ecosystem?

4. Which authority/authorities, in your opinion, should play a leading role in the integration and implementation processes of the EUDI Wallet in Estonia?
   a. In your opinion, what should be the division of roles between ministries/public authorities responsible for this initiative?

5. From an Estonian perspective, what challenges and opportunities are associated with the implementation of the EUDI Wallet?

    a. How does it impact the existing digital identity ecosystem in the country and which risks do you foresee?

6. How do you foresee the Estonian public responding to the introduction of the EUDI Wallet? Are there specific strategies in place to encourage user adoption and trust?

7. In the context of EUDI Wallet implementation, how does Estonia collaborate with various stakeholders, such as European Commission, EU member states, businesses, citizens, and other government entities?

8. How does the EUDI Wallet align with existing national legislation? Should any additional legal framework/agreements be established to ensure seamless cross-border services?

9. Looking ahead, what developments or enhancements are anticipated in Estonia's digital identity ecosystem, especially in connection with the EUDI Wallet?

10. What could be the most critical or essential use-cases of the EUDI Wallet in the Estonian context?

11. In your opinion, what could be the interest of private sector to offer their services and use the EUDI Wallet?

12. Would you like to add something else regarding the topic that has not been discussed yet?

# Appendix 3 – Interview questions for Estonian public and private sector stakeholders

**Introduction**

1. Please describe your current position and main responsibilities?
2. Please describe how are you related to the digital identity solutions implementation and/or eIDAS regulation in your organisation?

**Main interview questions**

1. How does your organisation's current digital identity infrastructure relate to Estonia's eID ecosystem?
    1.1. How significantly does the use of cross-border services impact your sector or organisation?
    1.2. How has the Single Digital Gateway played a role in shaping the services offered by your organisation?

2. What are the typical challenges faced while integrating digital identity solutions into existing systems in your field / organisation?
    2.1. What are the challenges in the context of cross-border services?

3. In your opinion, how does the integration of the EUDI Wallet impact your organisation's current digital identity infrastructure?

4. What incentives do you see for your organisation to adapt and integrate the EUDI Wallet?

5. In your field, what are the most important use-cases of the EUDI Wallet?

6.  Looking ahead, what are the key trends or developments in your field you anticipate regarding digital identity in the context of the EUDI Wallet's implementation?

7.  How does eIDAS relate to the legal acts applicable in your field?

8.  In your opinion, which Estonian authorities or organisations should take the lead in the integration and implementation processes of digital identity solutions?

9.  What role do you see for public-private partnerships in the implementation of the EUDI Wallet in Estonia?

10. How do you address concerns related to data privacy and security while implementing digital identity solutions for cross-border services in your field?

11. What technical infrastructure changes in your field are expected to support the integration of digital identity solutions for cross-border services?

12. Would you like to add something else regarding the topic that has not been discussed yet?

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