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FutureTrust – Future Trust Services for Trustworthy Global Transactions

Detlef Hühnlein[1], Tilman Frosch[2], Jörg Schwenk[2], Carl-Markus Piswanger[3], Marc Sel[4], Tina Hühnlein[1], Tobias Wich[1], Daniel Nemmert[1], René Lottes[1], Stefan Baszanowski[1], Volker Zeuner[1], Michael Rauh[1], Juraj Somorovsky[2], Vladislav Mladenov[2], Cristina Condovici[2], Herbert Leitold[5], Sophie Stalla-Bourdillon[6], Niko Tsakalakis[6], Jan Eichholz[7], Frank-Michael Kamm[7], Jens Urmann[7], Andreas Kühne[8], Damian Wabisch[8], Roger Dean[9], Jon Shamah[9], Mikheil Kapanadze[10], Nuno Ponte[11], Jose Martins[11], Renato Portela[11], Çağatay Karabat[12], Snežana Stojičić[13], Slobodan Nedeljkovic[13], Vincent Bouckaert[14], Alexandre Defays[14], Bruce Anderson[15], Michael Jonas[16], Christina Hermanns[16], Thomas Schubert[16], Dirk Wegener[17] and Alexander Sazonov[18]

[1]ecsec GmbH, Sudetenstraße 16, 96247 Michelau, Germany
[2]Ruhr Universität Bochum, Universitätsstraße 150, 44801 Bochum, Germany
[3]Bundesrechenzentrum GmbH, Hintere Zollamtsstraße 4, A-1030 Vienna, Austria
[4]PwC Enterprise Advisory, Woluwedal 18, Sint Stevens Woluwe 1932, Belgium
[5]A-SIT, Seidlgasse 22/9, A-1030 Vienna, Austria
[6]University of Southampton, Highfield, Southampton S017 1BJ, United Kingdom
[7]Giesecke & Devrient GmbH, Prinzregentestraße 159, 81677 Munich, Germany
[8]Trustable Limited, Great Hampton Street 69, Birmingham B18 6E, United Kingdom
[9]European Electronic Messaging Association AISBL, Rue Washington 40, Bruxelles 1050, Belgium
[10]Public Service Development Agency, Tsereteli Avenue 67A, Tbilisi 0154, Georgia

[11]Multicert – Servicos de Certificacao Electronica SA, Lagoas Parque Edificio 3 Piso 3, Porto Salvo 2740 266, Portugal
[12]Turkiye Bilimsel Ve Tknolojik Arastirma Kurumu, Ataturk Bulvari 221, Ankara 06100, Turkey
[13]Ministarstvo unutrašnjih poslova Republike Srbije, Kneza Miloša 103, Belgrade 11000, Serbia
[14]Arηs Spikeseed, Rue Nicolas Bové 2B, 1253 Luxembourg, Luxembourg
[15]Law Trusted Third Party Service (Pty) Ltd. (LAWTrust), 5 Bauhinia Street, Building C, Cambridge Office Park Veld Techno Park, Centurion 0157, South Africa
[16]Federal Office of Administration (Bundesverwaltungsamt), Barbarastr. 1, 50735 Cologne, Germany
[17]German Federal Information Technology Centre (Informationstechnikzentrum Bund, ITZBund), Waterloostr. 4, 30169 Hannover, Germany
[18]National Certification Authority Rus CJSC (NCA Rus), 8A building 5, Aviamotornaya st., Moscow 111024, Russia

E-mail: detlef.huhnlein@ecsec.de; tilman.frosch@rub.de; jorg.schwenk@rub.de; carl-markus.piswanger@brz.gv.at; marc.sel@be.pwc.com; tina.huhnlein@ecsec.de; tobias.wich@ecsec.de; daniel.nemmert@ecsec.de; rene.lottes@ecsec.de; stefan.baszanowski@ecsec.de; volker.zeuner@ecsec.de; michael.rauh@ecsec.de; juraj.somorovsky@rub.de; vladislav.mladenov@rub.de; cristina.condovici@rub.de; herbert.leitold@a-sit.at; sophie.stalla-bourdillon@soton.ac.uk; niko.tsakalakis@soton.ac.uk; jan.eichholz@gi-de.com; frank-michael.kamm@gi-de.com; jens.urmann@gi-de.com; kuehne@trustable.de; damian@trustable.de; r.dean@eema.org; jon.shamah@eema.org; mkapanadze@sda.gov.ge; nuno.pontemulticert.com; jose.martinsmulticert.com; renato.portelamulticert.com; cagatay.karabat@tubitak.gov.tr; snezana.stojicic@mup.gov.rs; slobodan.nedeljkovic@mup.gov.rs; vincent.bouckaert@arhs-developments.com; alexandre.defays@arhs-developments.com; bruce@LAWTrust.co.za; michael.jonas@bva.bund.de; christina.hermanns@bva.bund.de; thomas.schubert@bva.bund.de; dirk.dirkwegener@itzbund.de; sazonov@nucrf.ru;

Against the background of the regulation 2014/910/EU [1] on electronic identification (eID) and trusted services for electronic transactions in the internal market (eIDAS), the FutureTrust project[1], which is funded within the EU Framework Programme for Research and Innovation (Horizon 2020) under Grant Agreement No. 700542, aims at supporting the practical implementation of the regulation in Europe and beyond. For this purpose, the FutureTrust project will address the need for globally interoperable solutions through basic research with respect to the foundations of trust and trustworthiness, actively support the standardisation process in relevant areas, and provide Open Source software components and trustworthy services which will ease the use of eID and electronic signature technology in real world applications. The FutureTrust project will extend the existing European Trust Service Status List (TSL) infrastructure towards a "Global Trust List", develop a comprehensive Open Source Validation Service as well as a scalable Preservation Service for electronic signatures and seals. Furthermore, it will provide components for the eID-based application for qualified certificates across borders, and for the trustworthy creation of remote signatures and seals in a mobile environment. The present contribution provides an overview of the FutureTrust project and invites further stakeholders to actively participate in contributing to the development of future trust services for trustworthy global transactions.

14.1 Background and Motivation

There are currently over 160 trust service providers across Europe[2], which issue qualified certificates and/or qualified time stamps. Hence, the "eIDAS ecosystem"[3] with respect to these basic services is fairly well developed. On the other hand, the provision of qualified trust services for the validation and preservation of electronic signatures and seals as well as for registered delivery and the cross-border recognition of electronic identification schemes have been recently introduced with the eIDAS regulation [1]. However, these services are not yet broadly available in a mature, standardised, and interoperable manner within Europe.

In a similar manner, the practical adoption and especially the cross-border use of eID cards, which have been rolled out across Europe, is – despite

[1] See https://futuretrust.eu

[2] See [2, 3] and https://www.eid.as/tsp-map/ for example.

[3] See also https://blog.skidentity.de/en/eidas-ecosystem/.

previous and ongoing research and development efforts in pertinent projects, such as STORK, STORK 2.0, FutureID, e-SENS, SD-DSS, Open eCard, OpenPEPPOL and SkIDentity – still in its infancy. The opportunity afforded by the new eIDAS Trust Services regulation to use a national eID means outside of its home Member State, is still challenging and perceived to be complex. In particular, it is often not yet possible *in practice* to use eID cards from one EU Member State to enrol for a qualified certificate and qualified signature creation device (QSCD) in another Member State.[4]

In particular, the following problems seem to be not yet sufficiently solved and hence will be addressed in the FutureTrust project:

P1. No comprehensive Open Source Validation Service

Multiple validation services are available today. They range from offering revocation information to full validation against a formal validation policy. These services are operated by public and private sector actors, and allow relying parties the validation of signed or sealed artefacts. However, there is currently no freely available, standard conforming and comprehensive Validation Service, which would be able to verify arbitrary advanced and qualified electronic signatures in a trustworthy manner. To solve this problem, the FutureTrust project will contribute to the development of the missing standards and the development of such a comprehensive Validation Service.

P2. No scalable Open Source Preservation Service

The fact that signed objects lose their conclusiveness if cryptographic algorithms become weak induces severe challenges for applications, which require maintaining the integrity and authenticity of signed data for long periods of time. Research related to the strength of cryptographic algorithms is addressed in many places, including ECRYPT-NET[5], and does not fall within the scope of FutureTrust. Rather, the FutureTrust project will aim at solving this problem by contributing to the development of the missing standards for long-term preservation and the implementation of a scalable Open Source Preservation Service that makes use of processes and workflow to ensure preservation techniques embed the appropriate cryptographic solutions.

[4]Note, that such a cross-border enrolment for qualified certificates may become especially interesting in combination with remote and mobile signing services, in which no physical SSCD needs to be shipped to the user, because the SSCD is realized as central Hardware Security Module (HSM) hosted by a trusted service provider, which fulfils the requirements of [4], and against the background of the eIDAS-regulation (see e.g. Recital 51 of [1]) one may expect that such a scenario may soon become applicable across Europe and beyond.

[5]https://www.cosic.esat.kuleuven.be/ecrypt/net/

P3. Qualified electronic signatures are difficult to use in mobile environments

Today, applying for a qualified certificate involves various paper-based steps. Furthermore, to generate a qualified electronic signature, typically a smart card based signature creation device has to be used, which is complicated in mobile and cloud based environments due to the need for middleware and drivers that are often not supported on the mobile device. The FutureTrust project will aim at changing this by creating a Signature Service, which supports a variety of local and remote signature creation devices and eID-based enrolment for certificates and the remote creation of electronic signatures initiated by using mobile devices.

P4. Legal requirements of a pan-European eID metasystem

The first part of the eIDAS-regulation that deals with eID systems aims to create a standardized interoperability framework but does not intend to harmonize the respective national eID systems. Instead it employs a set of broad requirements, part of which is the mandatory compliance of all systems to the General Data Protection Regulation (GDPR) [5]. To facilitate compliance with the GDPR, the FutureTrust project will conduct desk research to analyse how privacy and data protection legislation impacts on existing laws and derive a list of necessary characteristics that an EU eID and eSignatures metasystem should incorporate to ensure compliance.

P5. Legally binding electronic transactions with non-European partners are hard to achieve

While the eIDAS-regulation [1] defines the legal effect of qualified electronic signatures, there is no comparable global legislation and hence electronic transactions with business partners outside the European Union are challenging with respect to legal significance and interoperability. To work on a viable solution for this problem the FutureTrust project will conduct basic research with respect to international legislation, contribute to the harmonization of the relevant policy documents and standards and build a "Global Trust List", which may form the basis for legally significant electronic transactions around the globe.

P6. Scope of eIDAS interoperability framework is limited to EU

In a similar manner, the scope of the interoperability framework for electronic identification according to Article 12 of [1] is limited to the EU. There are many aspects of an international interoperability framework that need to be

assessed, especially in regard of to the privacy and data protection aspects highlighted above.[6] Against this background, the FutureTrust project will extend the work from pertinent research and large-scale pilot projects to integrate non-European eID-solutions in a seamless and trustworthy manner, after defining the requirements and assessing the impact of data transfers beyond the European Union.

P7. No formal foundation of trust and trustworthiness

To be able to compare eID solutions on an international scale, there is no international legislation which would allow to "define" trustworthiness. Instead, scientifically sound formal models must be developed which describe international trust models, and especially model to compare the trustworthiness of different eID services.

To demonstrate the viability and trustworthiness of these formal models, and show that the developed components can be used in productive environments, the FutureTrust project will implement real world pilot applications in the area of public administration, higher education, eCommerce, eBusiness and eBanking.

14.2 The FutureTrust Project

In order to solve the problems mentioned above, the FutureTrust partners (see Section 14.2.1) have sketched the FutureTrust System Architecture (see Section 14.2.2), which includes several innovative services, which are planned to be used in a variety of pilot projects (see Section 14.2.8).

This will in particular include the design and development of a Global Trust List (gTSL) (see Section 14.2.3), a Comprehensive Validation Service (ValS) (see Section 14.2.4), a scalable Preservation Service (PresS) (see Section 14.2.5), an Identity Management Service (IdMS) (see Section 14.2.6) and importantly a Signing and Sealing Service (SigS) (see Section 14.2.7).

14.2.1 FutureTrust Partners

The FutureTrust project is carried out by a number of core partners as depicted in Figure 14.1, which includes Ruhr-Universität Bochum (Germany), ecsec GmbH (Germany), Arhs Spikeseed (Luxembourg), EEMA

[6]For example, data transfers to the US are currently not clearly regulated after the invalidation of the 'Safe Harbor' agreement by the EUCJ (C-362/14). The EU officials were in negotiations on a new arrangement, named 'EU-US Privacy Shield' which was halted after a contradictory opinion from the WP29 (WP238).

Figure 14.1 FutureTrust partners.

(Belgium), Federal Computing Centre of Austria (Austria), Price Waterhouse Coopers (PWC) (Belgium), University of Southampton (United Kingdom), multicert (Portugal), Giesecke & Devrient GmbH (Germany), Trustable Ltd. (United Kingdom), Secure Information Technology Center – Austria (Austria), Public Service Development Agency (Georgia), Türkiye Bilimsel veTeknolojik Araşrma Kurumu (Turkey), LAW Trusted Third Party Services (Pty) Ltd. (South Africa), Ministry of Interior Republic of Serbia (Serbia), DFN-CERT Services GmbH, the PRIMUSS cluster consisting of ten Universities of Applied Science and the Leipzig University (LU) Computing Centre (Germany).

Furthermore the FutureTrust project is supported by selected subcontractors and a number of associated partners, which currently includes the SAFE Biopharma Association (USA), The Data Processing Center (DPC) of the Ministry of Transport, Communications and High Technologies of the Republic of Azerbaijan, Signicat, SK ID Solution AS, B.Est Solutions, UITSEC Teknoloji A.Ş., and Comsign Israel.

14.2.2 FutureTrust System Architecture

As shown in Figure 14.2, the FutureTrust system integrates existing and emerging eIDAS Trust Services, eIDAS Identity Services and similar Third

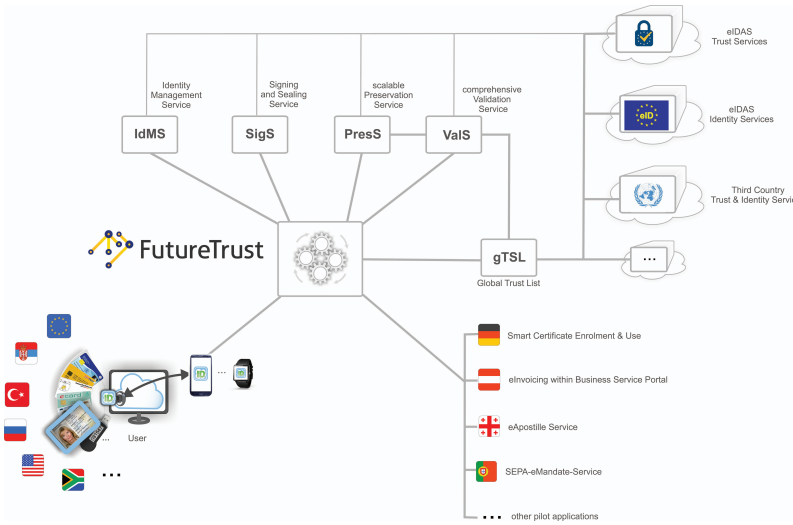

Figure 14.2 FutureTrust System Architecture.

Country Trust & Identity Services and provides a number of FutureTrust specific services, which aim at facilitating the use of eID and electronic signature technology in different application scenarios.

14.2.3 Global Trust List (gTSL)

The gTSL will become an Open Source component, which can be deployed with the other FutureTrust services or as standalone service and which allows to manage Trust Service Status Lists for Trust Services and Identity Providers. The gTSL will allow to import the European "List of the Lists" (LotL), which is a signed XML document according to [6] and all national Trust Service Status Lists (TSLs) referenced therein. This LotL is currently published by the European Commission. This import includes a secure verification of the digital signatures involved. The gTSL will also allow to import Trusted Lists from other geographic regions, such as the Trust List of the Russian Federation[7] for example, and it is envisioned that the gTSL will generate a "virtual US-American Trust List" from the current set of available cross-certificates. gTSL will provide support for the traceable assessment of trust related aspects for potential trust anchors both with and

[7] See http://e-trust.gosuslugi.ru/CA/DownloadTSL?schemaVersion=0.

without known trustworthiness and assurance levels[8] by providing claims or proofs of relevant information with respect to the trustworthiness of a trust service. This may give rise for a reputation based "web of trust" for trust services. It is expected that the corroboration of information from relatively independent sources[9] will help to establish trustworthiness. Furthermore, the gTSL provides a web interface as well as a REST interface allowing for a small set of predefined queries, to allow the other FutureTrust services or other gTSL deployments to access the validated data. For implementation of the underlying gTSL model various options have already been identified. These include traditional models such as a Trusted Third Party model and a Trust List, as well as innovative models such as a semantic web ontology and a blockchain ledger.

14.2.4 Comprehensive Validation Service (ValS)

The major use case of ValS is the validation of Advanced Electronic Signatures (AdES) in standardized formats, such as CAdES, XAdES and PAdES for example. In order to support the various small legal and regulatory differences with respect to electronic signatures coming from different EU Member States or other global regions, the ValS will support practice oriented XML-based validation policies for electronic signatures, which consider previous work in this area, such as [7] and [8] and current standards, such as [9] and [10] for example. The ValS issues a verification report to the requestor of the service, which is based on the recently published ETSI TS 119 102-2 signature validation report, which in particular considers the procedures defined in [9] and the XML-based validation policies mentioned above. Finally, it seems worth to be mentioned that the ValS is designed in a modular and extensible manner, such that modules for other not (yet) standardized signatures or validation policies can be plugged into the ValS in a well-defined manner.

14.2.5 Scalable Preservation Service (PresS)

The PresS is used to preserve the integrity and conclusiveness of a signed document over its whole lifetime. For this purpose the FutureTrust

[8] [1] implicitly defines the levels "qualified" and "non-qualified" for trust service providers and explicitly introduces in Article 8 the assurance levels "low", "significant" and "high" for electronic identification schemes.

[9] See [11].

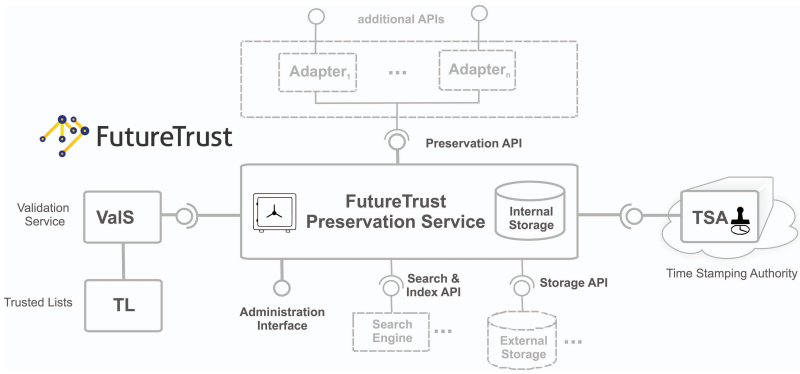

Figure 14.3 Outline of the Architecture of the Scalable Preservation Service.

Preservation Service as outlined in Figure 14.3 will use the ValS and existing external time stamping services to produce Evidence Records according to [12]. As depicted in Figure 14.3 the Preservation Service supports the input interface, which is currently standardised in ETSI TS 119 512 and smoothly integrates with various types of storage systems.

The FutureTrust Preservation Service will support a variety of Archive Information Packages including the zip-based container based on the Associated Signature Container (ASiC) specification according to [13]. An important goal of the envisioned Preservation Service is scalability, which may be realized by using efficient data structures, such as Merkle hash trees as standardized in [12] for example. Using hash tree based signatures[10] may also provide additional security in the case that quantum computers have been built, because any digital signature that is in use today (based on the RSA assumption or on the discrete log assumption) can be forged in this case. However, message authentication codes (MACs), block-chain constructions and signature algorithms based on hash-trees seem to remain secure. Thus it is an interesting research question, whether fully operational and sufficiently performant preservation services can be built on MACs, block-chains or hash-trees alone.

14.2.6 Identity Management Service (IdMS)

Many EU Member States and some non-European countries have established eID services, which produce slightly different authentication tokens. Within

[10] See [14].

the EU, most[11] of these services produce SAML tokens (see [15]) and the eIDAS interoperability framework [16] is also based on [17]. In addition, industrial standardization activities have produced specifications like FIDO[12] or GSMA's MobileConnect[13] which have gained a broad customer base. The IdMS is based on SkIDentity [18] and is able to consume a broad variety of such authentication tokens (SAML, OpenID Connect, OAuth), work with a broad variety of mobile identification services (FIDO, GSMA Mobile-Connect, European Citizen cards) and transform them into a standardized, interoperable[14] and secure[15] format. The choice of this standardized format will be based on industry best practices, and on the eIDAS interoperability framework [16]. Moreover, the IdMS supports a large variety of European and non-European eID cards, platforms and application services.

14.2.7 Signing and Sealing Service (SigS)

The SigS allows to create advanced and qualified electronic signatures and seals using local and remote signature generation devices. For this purpose, the SigS is operated in a secure environment and supports appropriate standard interfaces based on OASIS DSS-X Version 2.

As outlined in Figures 14.4 and 14.5, one may distinguish the enrolment phase and the usage phase. During enrolment, the Signatory uses his eID and the IdMS to perform an eID-based identification and registration at the SigS and the Certification Authority (CA), which involves the creation of signing credentials, which can later on be used for signature generation. Thanks to the

[11] The [19] system seems to be an exception to this rule, as it produces and accepts identity tokens according to the [20] specification.

[12] See [21].

[13] See [22] and [23].

[14] Due to the fact that SAML is a very complex and highly extensible standard, the integration of different eID services considering all extensions points is a rather challenging task. In order to enable the communication between all eID services, their interoperability has to be thoroughly analysed.

[15] Based on [16] it is clear that SAML 2.0 will form the basis for eIDAS Interoperability Framework according to Article 12 of [1] and [24], but it is currently likely that the Assertions will be simple "Bearer Tokens", which is not optimal from a security point of view. Furthermore, the different authentication flows and optional message encryptions result in complex standard and thus expose conforming implementations to new attacks. In the last years, several papers (see e.g. [25]) showed how to login as an arbitrary use in SAML Single Sign-On scenarios or decrypt confidential SAML messages (see e.g. [26]). Thus, existing eID services can be evaluated against known attacks.

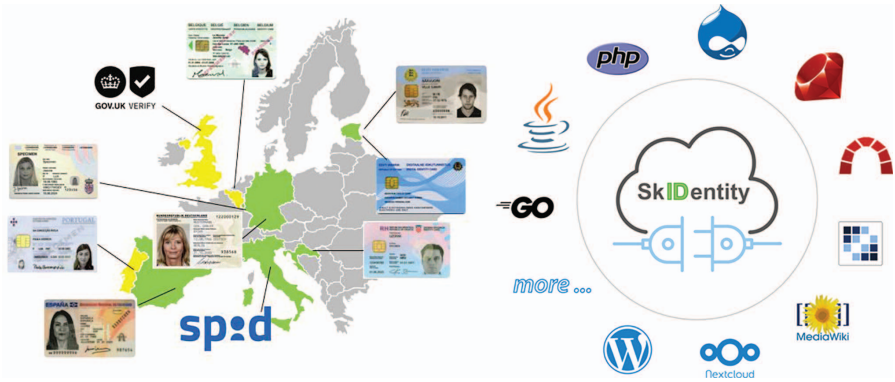

Figure 14.4 National eID cards, platforms and applications supported by IdMS.

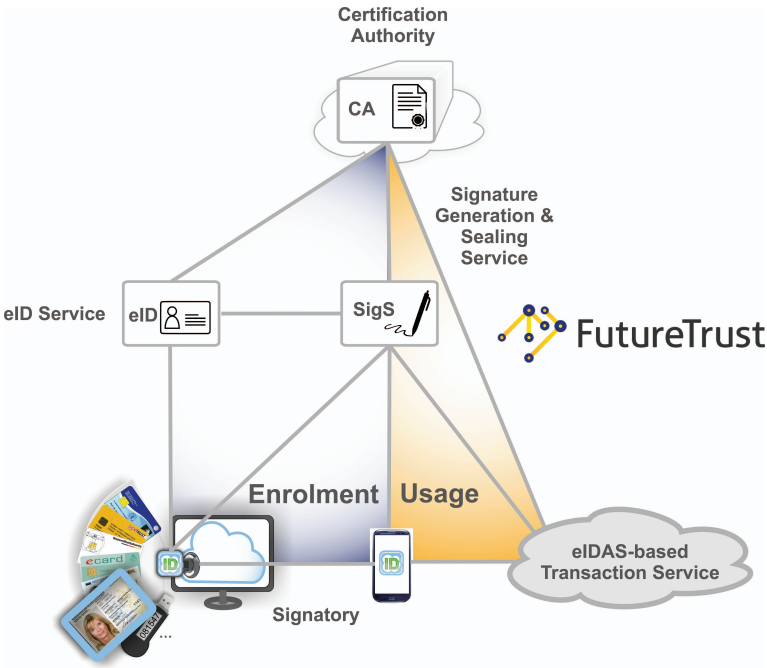

Figure 14.5 Enrolment and usage phase for SigS.

OASIS DSS Extension for Local and Remote Signature Computation [27] it is possible to use both smart card and cloud-based signature creation devices.

14.2.8 FutureTrust Pilot Applications

The FutureTrust consortium aims to demonstrate the project's contributions in a variety of demonstrators and pilot applications, which are planned to include University Smart Certificates Enrolment & Use, e-Invoicing with the Business Service Portal of the Austrian Government, an e-Apostille Validation System and a SEPA e-Mandate Service according to [28] for example. Furthermore, the FutureTrust project is open for supporting further pilot applications related to innovative use cases for eID and electronic signature technology.

14.2.9 The go.eIDAS Initiative

It is recognised that the FutureTrust Service components that will be made available exist in the eIDAS ecosystem and all exploitation efforts must reflect the early stages of Trust Services deployment and market maturity. In order to establish FutureTrust to be sustainable and to maintain its relevance, it is essential to obtain the best possible support for the exploitation efforts, especially from others than the FutureTrust Partners, Associate Partners and Advisory Board Members. To this end, the go.eIDAS[16] initiative will act as the exploitation vehicle for FutureTrust, but will also have sufficient branding to continue after the end of the Horizon 2020 funding.

Planning and initial contacts with Stakeholders commenced with the launch press release on 27/09/2018, in conjunction with the formal start of EU recognition of notified eIDs[17].

go.eIDAS reflects the private sector need to interoperate with eIDAS and also to interoperate with non-EU based Trust Schemes. go.eIDAS is an open initiative, which welcomes all interested organisations and individuals who are committed to the goals of eIDAS and FutureTrust. We recognise that a thriving community with a spectrum of needs must be created over and above the users of FutureTrust.

[16] See https://go.eid.as

[17] See https://www.eid.as/news/details/date/2018/09/27/goeidas-initiative-launched- across-europe-and-beyond-1/.

14.3 Summary and Invitation for Further Collaboration

This paper provides an overview of the FutureTrust project, which started on June 1st 2016 and is funded until August 2019 by the European Commission within the EU Framework Programme for Research and Innovation (Horizon 2020) under the Grant Agreement No. 700542 with up to 6,3 Mio. €.

As explained throughout the paper, the FutureTrust project has conducted basic research with respect to the foundations of trust and trustworthiness, actively support the standardisation process in relevant areas, and plans to provide innovative Open Source software components and trustworthy services which will enable ease the use of eID and electronic signature technology in real world applications by addressing the problems P1 to P7 introduced in Section 14.2.

As part of the continuation of this project, and its subsequent exploitation, the FutureTrust consortium invites interested parties, such as Trust Service Providers, vendors of eID and electronic signature technology, application providers and other research projects to benefit from this development and join the FutureTrust team in its new go.eIDAS initiative.

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