The Estonian ID Card and Digital Signature Concept

Principles and Solutions

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Contents

Status of the document

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Introduction

Estonia has implemented ID card as the primary document for identifying its citizens and alien residents living within the country. The card, besides being a physical identification document, has advanced electronic functions that facilitate secure authentication and legally binding digital signature, in connection with nationwide online services.

This whitepaper gives an overview of the principles behind the project and explains the choices and decisions made while carrying out the card project. It also presents an overview of how the associated services and applications are implemented.

Intended audience

The first part of the whitepaper, "Principles", is written for decision-makers and potential common users from a legal and economic perspective. The second part, "Solutions", is for implementers and assumes knowledge about basic PKI concepts.

Current project status

The first Estonian ID cards were issued in January 2002. In one year, more than 130 000 cards have been issued, and the total figure is expected to grow to more than 350 000 by the end of 2003 (about 25% of the whole population).

The card is meant to be universal and its functions are to be used in any form of business, governmental or private communications. It is already helping people to make everyday communications more convenient. You can find more details about the implementation and applications below.

Principles

Digital signature regulation

Estonian parliament (Riigikogu) passed the Digital Signature Act (hereinafter DSA) on March 8, 2000, and it entered into force on December 15, 2000. The law regulates issues that are essential for implementing a nationwide PKI and digital signature infrastructure. The law is available online at http://www.legaltext.ee/text/en/X30081K3.htm.

Digital signature concept

According to the Estonian DSA, digital signatures are equivalent to handwritten ones, provided that they are compliant with the requirements set forth in DSA and if other laws do not regulate otherwise. Thus as a rule, digital and handwritten signatures should be equivalent in document management in both public and private sectors. DSA also states that public sector organizations must accept digitally signed documents.

The requirements set forth in DSA to digital signatures state that digital signature must uniquely identify the signatory, be bound to the signed data in such a way that makes changing the data after signing impossible without invalidating the signature, and identify the time of signing (assuming the use of time-stamping or equivalent time establishment technology).

In the terms of EC directive 1999/93/EC, DSA only regulates advanced electronic signatures. Other types of electronic signatures can of course be used, but DSA does not give them legal power.

Certification Service Providers (CSP-s)

DSA regulates the work of CSP-s in Estonia, setting forth requirements to them and regulating their operation and supervision. CSP-s may only be legal entities with a regulated minimum share capital, they must be entered in the National Certificate Service Provider Registry (see below) and must carry out an annual audit to ensure organization and system reliability. CSP-s must also have liability insurance to safeguard against compensating faults made while providing the service.

It is important to note that according to DSA, CSP-s certify only real persons identifiable by name and ID code – issuing certificates to pseudonyms is not currently covered by DSA. It was discussed in the parliament during the law adoption process, but was considered to be an additional unnecessary risk and so far, no need for this has been seen.

Time-stamping Service Providers (TSP-s)

DSA also regulates the work of TSP-s and the comparison of time stamps between TSP-s. The requirements to service providers are generally the same as those to CSP-

s. According to DSA, a time stamp is simply a data unit that proves that certain data existed at a certain moment. DSA does not define time stamps in more detail, but states that they must be bound to the timestamped data and issued in such a way that it would be impossible to change the timestamped data without invalidating the timestamp.

Supervision – Registry and Ministry

The National Registry of Certification Service Providers contains data about all Estonian CSP-s and TSP-s. Although it confirms the public keys of CSP-s, it is technically not a root CA in Estonia. Instead, it functions as a supervisory authority, confirming the results of service providers' annual audits among other things. The Ministry of Economy and Communications, in whose administration area the registry works, has the right to verify audit results and inspect the service providers' premises and relevant information.

Foreign Certificates

DSA regulates the recognition of foreign certificates, stating that in order for them to be recognized equivalent to those issued by Estonian CSP-s, they must be either confirmed by a registered CSP, be explicitly compliant with DSA requirements or covered by an international agreement.

Identity Document Regulation

Identity documents in Estonia are regulated by the Identity Documents Act. The law is available online at http://www.legaltext.ee/text/en/X30039K7.htm.

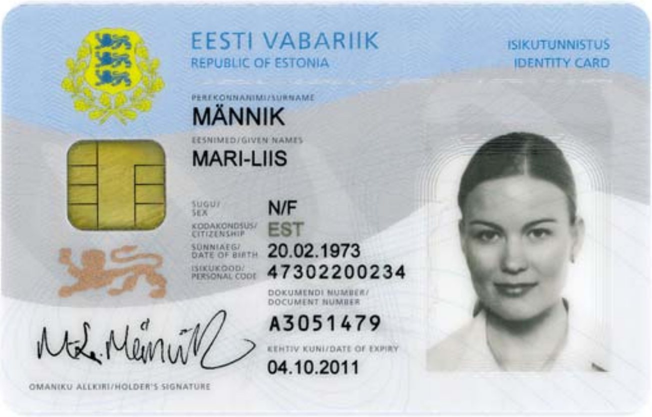
Mandatory document

According to the Act, possessing an ID card is mandatory for all Estonian residents and also for all aliens who reside permanently in Estonia on the basis of a valid residence permit with a period of validity of at least one year. There are no sanctions for not having a card, but it is expected that as the first Estonian passports were issued in 1992 with validity period of 10 years and they are expiring, most people will apply for either only ID card, or ID card together with passport when renewing their documents in the period 2002-2006. By the end of 2006, one million cards will have been issued.

There is only one version of the document: there are no different optional features that users can opt out of or choose to (not) have. All documents are equipped with a chip containing electronic data and certificates (see below). It is understood that some users may have doubts or fears about electronic use of the card, but remedies are provided for that: if users do not wish to use the electronic functions of their cards, they can suspend the validity of their certificates, thus making it impossible to use the card electronically. Certificate suspending or revoking also removes user's data from public certificate directory.

Card appearance and layout

The card looks as follows.



EESTI VABARIIK
REPUBLIC OF ESTONIA

ISIKUTUNNISTUS
IDENTITY CARD

PEREKONNANIMI/SURNAME
MÄNNIK

EESNIMED/GIVEN NAMES
MARI-LIIS

SUGU/SEX N/F

KODAKONDSUS/CITIZENSHIP EST

SÜNNIAEG/DATE OF BIRTH 20.02.1973

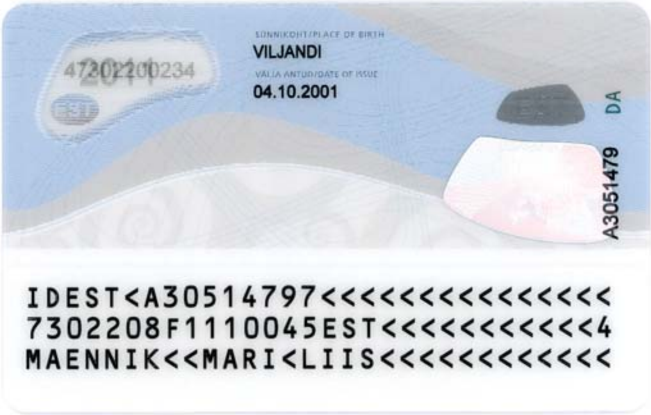
ISIKUKOOD/PERSONAL CODE 47302200234

DOKUMENDI NUMBER/DOCUMENT NUMBER
A3051479

KEHTIV KUNI/DATE OF EXPIRY
04.10.2011

OMANIKU ALLKIRI/HOLDER'S SIGNATURE

Front side of the Estonian ID card.



47302200234

SÜNNIKOHT/PLACE OF BIRTH
VILJANDI

VÄLJA ANTUD/DATE OF ISSUE
04.10.2001

DA

A3051479

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IDEST<A30514797<<<<<<<<<<<<<<<
7302208F1110045EST<<<<<<<<<<<4
MAENNIK<<MARI<LIIS<<<<<<<<<<<<
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Back side of the Estonian ID card.

The front side of the card contains the card holder's signature and photo, and also the following data:

- name of card holder
- personal code (national ID code) of card holder
- card holder birth time
- card holder sex
- card holder citizenship
- residence permit details and other information (if applicable)
- card number
- card validity end

The back side contains the following data:

- card holder birth place
- card issuing date
- card and holder data in machine-readable (ICAO) format

Electronic data on card

Each ID card contains various pieces of data. All the above data except photo and handwritten signature are also present on the card in electronic form, in a special publicly readable data file. In addition, the card contains two certificates and their associated private keys protected with PIN codes. The certificates contain only the holder's name and personal code (national ID code). In addition, the authentication certificate contains the holder's unique e-mail address. Read more about certificates and e-mail address below.

Certificates

Each issued ID card contains two certificates: one for authentication and one for digital signing. There are also two associated private keys, protected by two separate PIN codes, on the card. The certificates contain no restrictions of use: they are by nature universal and meant to be used in any form of communications, whether between private persons, organizations or the card holder and government. They contain no roles or authorizations: those most come using some out-of-band method (also see below, "Roles, authorizations and organizations' validations").

The certificates contain the card holder's name and national ID code. It is agreed in Estonia that this data is public by nature. The certificates identify the card holder uniquely because even though there may be name overlaps, the national ID code is unique. In addition, the authentication certificate contains the card holder's e-mail address.

E-mail address

The authentication certificate on each ID card contains the card holder's government-assigned e-mail address in the format firstname.lastname_NNNN@eesti.ee, where NNNN are four random numbers. The random numbers are necessary to provide unique e-mail addresses even to persons with the same name. The address does not change with subsequent certificate or card issuing – it is guaranteed to be a person's "lifetime" address.

There is no real e-mail service associated with the address. It is a merely a relay address which forwards e-mails to users' "real" addresses (e-mail accounts). Each user must configure the forwarding addresses using an online service made available for this purpose, and may reconfigure the addresses as often as he or she pleases. Up to five forwarding addresses can be specified.

The address is supposed to be used in communications from government to the person, but it can also be used in communications between persons and companies and private persons themselves. The addresses are available online to anyone through CSP-s certificate directory.

The address can be used as a simple e-mail address, but using the address and the authentication certificate on the card, users can also digitally sign and encrypt their e-mail. The digital e-mail signature is not legally binding and not covered by DSA, but it provides receivers additional confirmation of sender authenticity. E-mail encryption and signing using certificates on smart card is a standard function of various e-mail applications.

Anti-spam measures are implemented in the forwarding server. In addition, spamming is illegal in Estonia and spammers will be prosecuted accordingly.

Data protection

The data protection question is not very relevant in the context of Estonian ID card because there is very little private data involved in the card issuing and further utilization process. There is a broad Personal Data Protection Act in effect in Estonia which regulates the use of personal data and databases containing personal data by public authorities and private entities, and Estonian Data Protection Inspection is the government body overseeing that the requirements of the act are met and enforcing compliance if necessary.

The certificates on the card are available publicly in a directory service and contain only the card holder's name and personal ID code, which are considered public data by nature in Estonia. In addition, e-mail addresses in authentication certificates are also available in the directory. The directory contains only valid (active) certificates: if a person suspends or revokes his certificate, it is also removed from the directory and the data are no longer available.

The public data file is not published anywhere online. The personal data on the card in visual and electronic format are accessible only to those persons to who the card holder physically presents the card.

The general stance to ID card and data protection in Estonia is that the card should contain as little private data as possible. Instead, the data should be kept in databases at relevant authorities, and a person can use the card as key (authorization method) to access his or her data in the database.

Organizational structure, card issuing and operation

The card issuing as well as its further operation is done in close public private partnership. There are three main organizations who are associated with issuing and operating the ID card and the associated infrastructure.

Estonian Citizenship and Migration Board (hereinafter CMB) is the government organization responsible for issuing identification documents to Estonian citizens and alien residents, as required in the Identity Documents Act. CMB is in the supervision area of Estonian Ministry of the Interior. CMB receives the card application from citizens.

AS Sertifitseerimiskeskus ("certificate centre", hereinafter SK), founded by two major Estonian banks Hansapank and Eesti Ühispank and two telecom companies Eesti Telefon and EMT, functions as CA, maintains the electronic infrastructure necessary for issuing and using the card, and develops the associated services and software. SK also takes care of delivering the card to its holder through Hansapank and Eesti Ühispank bank offices.

TRÜB Baltic AS, subsidiary of Swiss TRÜB AG, is the company that personalizes the card.

The card issuing process consists of the following steps.

1. person fills in application for the card, indicating the bank branch office where he or she would like to receive the card
2. CMB receives application from person
3. CMB stores the application and forwards its data to TRÜB
4. TRÜB personalizes the card

5. TRÜB gives the card the order of generating private keys (internal function of the card, the keys will never leave the card) and prepares the secure PIN envelopes
6. TRÜB formulates certificate requests (2 per card) and forwards them to SK
7. SK issues the certificates, stores them in its directory and returns the certificates to TRÜB
8. TRÜB stores the certificates and personal data file on the card chip
9. TRÜB prepares the final delivery envelope, enclosing the card, secure PIN envelope and an introductory brochure
10. TRÜB hands the final delivery envelope over to CMB
11. CMB hands the final delivery envelope over to SK (CMB has outsourced the card delivery to SK)
12. SK sends delivery envelope to the bank branch specified in the original application (done using security couriers)
13. person receives the delivery (containing card and PIN codes in separate envelopes) from the bank branch office
14. upon receipt of the card, certificates are activated and published in directory

For further operation of the card, SK maintains the associated electronic services including an LDAP directory service, OCSP validation service and other necessary services for online validity and digital signature confirmations. SK also provides the software to anyone interested in creating applications to the card and digital signature, and provides a readymade client and web portal for giving and verifying digital signatures (see below, "Document format and DigiDoc"). In addition, SK maintains a 24-hour telephone hotline which can be used for immediately suspending the validity of certificates in case of card loss or theft.

Solutions

Following are a number of issues and questions that have been solved when implementing the Estonian ID card and digital signature infrastructure.

Certificate profiles and e-mail addresses

The certificates on Estonian ID cards are standard X509v3 certificates. The authentication certificate contains the card holder's e-mail address. The certificate profile is available in a separate document.

Certificate validity verification methods

According to Estonian DSA, CSP-s must provide "a method of verifying certificate validity online". SK as the issuer of certificates to ID cards provides users three ways of checking certificate validity.

CRL-s are provided, containing the list of suspended and revoked certificates. CRL-s are standard but outdated method, because as of January 2003, CRL size has grown to over 1 MB in one year and it is not very convenient to use. CRL-s are mainly provided for backwards compatibility and standards compliance. SK updates its CRL twice a day. Delta CRL-s are not provided.

The second method is an LDAP directory, containing all valid certificates. The directory is updated in real time – if a certificate is activated, it is uploaded to the directory, and if it is suspended or revoked, it is removed from there. Among other things, this provides everyone a chance of finding the e-mail address of any ID card holder. Restrictions are in effect as to the maximum number of responses returned to one LDAP query to protect against server overload.

The most convenient method of verifying certificate validity is SK-s OCSP service. It can be used for simple certificate validity confirmations, but also for validity confirmations ("notary confirmations") to digital signatures. SK provides a standard OCSP service compliant with RFC 2560. An important detail is that according to the RFC, OCSP responses are supposed to be based on CRL-s and therefore may not necessarily reflect the actual certificate status. In contrast, SK has implemented its OCSP service in such a way that it operates directly off its master CA certificate database and does not use CRL-s. Thus, SK-s OCSP responses reflect actual (real-time) certificate status. In terms of the RFC, the response's thisUpdate and producedAt fields are equivalent.

OCSP, time-stamping and evidentiary value of digital signatures

For legally binding digital signatures, time is an extremely important factor. According to the Estonian DSA as well as common sense, only signatures given using a valid certificate are to be considered valid. On the other hand, to provide remedy to the risk that the signing device (ID card) may be stolen together with PIN-s and digital signatures could be given on behalf of the user by someone else, users have the chance of suspending their certificate validity using a 24-hour telephone hotline operated by SK. With these two concepts combined, users must be able to clearly differentiate the signatures given using a valid certificate from those given using a suspended or revoked certificate. Thus, there is a need for a time-stamping and validity confirmation service which binds the signature, time and certificate validity.

Another important concept concerning signature validity is that the signature must be valid also when the certificate has already expired or been revoked. If a certificate is suspended by the card holder or anyone else, the card holder can reactivate it at a bank office.

A number of experimental time-stamping protocols and technologies have been proposed, but no common understanding or agreements of time-stamping is present, the experimental technologies are under constant development and not in mass use. Thus, an innovative approach was needed. SK chose to base its time-stamping implementation on standard OCSP. The protocol contains a Nonce field, which protects against replay attacks. Instead of cryptographically random data, the Nonce field is set to contain the hash of the data to be signed, because it can also be interpreted as just a random number. According to the RFC, the OCSP responder signs its response which in SK-s case, contains the original nonce (document hash), response providing/signing time and ID of the certificate used to give the signature, binding the three pieces of data together and providing the validity confirmation for the digital signature. SK stores the signed response in its log as evidence material.

SK has implemented all of the above, including both client and server parts, in its DigiDoc digital signature architecture.

Document format and DigiDoc

In order to bring digital signatures into everyday life, common understanding and signature handling practices are required. In addition, software and technology must be available for anyone interested, in order to create compatible applications. After all, the key to unleashing potential digital signature benefits lies in communication between organizations, not within one organization. Therefore, it is vital that all organizations in a given community interpret and understand digital signatures the same way. In case of Estonia, the community is the whole country.

A number of digital signature implementations and applications are available on the market, all claiming to be suitable for specific purposes. However, no known application or implementation of the latest standards was found which would suit the needs of the Estonian project, and reliance on foreign software providers guaranteeing the functioning of a country's everyday life relying on digital signatures can also be seen as a strategic risk. Therefore, a whole new approach – and a whole new software architecture – was needed.

In 2002, SK together with its partners created an all-around digital signature architecture dubbed DigiDoc. As the name suggests, DigiDoc aims to meet all the needs users might have about digital signature creation, handling and verification.

On the server side, DigiDoc provides an RFC2560-compliant OCSP server, operating directly off the CA master certificate database and providing validity confirmations to certificates and signatures. On the client side, it provides a number of components.

The most important component is digital document format, which is key to common digital signature implementation and practice. As of 2002, a number of standards have been adopted or are in preparation. SK based the DigiDoc document format on XML-DSIG standard. However, it has several shortcomings such as allowing only one signature per document, and in February 2002, ETSI published its extensions to XML-DSIG as ETSI TS 101 903, also known as XAdES. DigiDoc document format is a profile of XAdES, containing a subset of its proposed extensions. The DigiDoc format is described in a specification document.

Based on the document format, a library was developed in C language which binds together the following:

- DigiDoc document format
- SK-s OCSP validation service
- Interfacing with the user's ID card using Windows' native CSP interface or cross-platform PKCS#11

The DigiDoc library provides easy-to-use interfaces to all of the above and there is no need for application developers to know OCSP protocol specifics or DigiDoc (XAdES, XML-DSIG) format internals. It can be embedded in any application and on top of it, a COM interface has been implemented, making it easy to add DigiDoc support to any Windows application supporting COM technology. A Java implementation is also provided.

However, providing the libraries and formats was not enough because these do not add value to end users without real applications. Although it is expected that DigiDoc support will eventually be present in most Estonian document management systems, web sites dealing with documents etc, a number of example or "reference" applications are also provided. DigiDoc Client is a Windows application that lets users simply sign and verify documents, and DigiDoc portal is an application that lets users do the same online without the need to install any stand-alone software. Naturally, both are based on the same DigiDoc library and thus fully compatible – signatures given in Client can be verified in portal and vice versa.

The libraries, specifications and applications are provided to Estonian public free of charge, and it is expected that digital signature usage in common life and everyday business and government practices will grow significantly already in 2003. The first official digital signatures in Estonia were given using DigiDoc Client only on October 7, 2002, and implementing the digital signature on a national scale naturally takes some time.

Roles, authorizations and organizations' validations

In connection with implementing PKI and digital signatures, the question of roles and authorizations has arisen in various projects. It is assumed that certificates for digital signing may be issued for specific purposes only, and that a person's roles can be embedded in role certificates that are then used for authenticating the certificate holder into different systems and giving digital signatures in different roles. Thus, a person needs additional role and signature certificates for each different role he or she has, and the number of certificates grows, creating substantial interoperability and scalability issues.

The Estonian approach states (as also said in the Estonian DSA) that a digital signature given using a digital signing certificate is no different than a handwritten one. A person's handwritten signature does not contain his or her role – the role and authorization are established using some out-of-band method (out-of-band in the context of certificates). The same approach also goes for authorization while authenticating – a person's certificate should not contain his or her authorization credentials. Instead, everyone has a similar universal key (authentication certificate), and the person's role and authorization can be determined using some other method (e.g. an online database) based on that key.

An exception to the above is organization's validation. Digital documents sometimes need to be validated by organizations, so that other organizations can be sure of the identity of the organization where the document originated. This is useful for e.g. signing pieces of databases (e.g. bank statements) online, to be presented to other organizations. For this, SK issues certificates to organizations that can be used to sign documents digitally. Technically, they are equivalent to personal signing certificates on everyone's ID card, but legally, they are not viewed as signatures and need not be covered by law, because according to the Estonian law, only real persons can give signatures. The "organizations' signatures" must therefore be viewed simply as additional tools for proving information authenticity (that it really originated from a specific organization) which may or may not be accompanied by a digital signature of a real person working in that organization. Still, the PKI complexity stops here, and besides personal and organizational signature certificates, there is no need for personal role certificates or anything else more complex.

New ideas: replacement and alternative cards

As of the beginning of 2003, a number of ideas are being discussed for improving the availability and usability of digital signatures in Estonia. One of them is the "replacement ID card", or backup card. The main concern here is that the card issuing process described above is quite complex and according to current regulations, it may take up to 30 days for a person from the moment of presenting the application to receiving the card. If a card is lost or damaged and a person needs to get a new one, this may mean that he or she may not be able to give digital signatures for 30 days which may not be acceptable in some high-stake business environments. Therefore, a possibility could be established that current ID card holders might get a "backup card" to minimize the extent of the above problem. However, this is currently not implemented, and another remedy for the problem is that the above organizations will just implement an "express service" which would be more expensive but quicker method of getting an ID card in the "normal" way.

Another idea is that of "alternative card". National ID card need not be the only carrier of digital signing certificates. Some large companies are already using smart cards for their internal services, and would like to have digital signing certificates issued by SK to be added to their internal cards. The company itself would then act as Registration Authority, and SK would be responsible for issuing certificates in response to certificate requests, as is also the case with regular ID cards. Still, this "alternative card" will remain a niche solution and for the general public, the Estonian national ID card is the universal signing tool for whatever role a person may be acting in.