Open Source eID Projects

RMLL

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Agenda

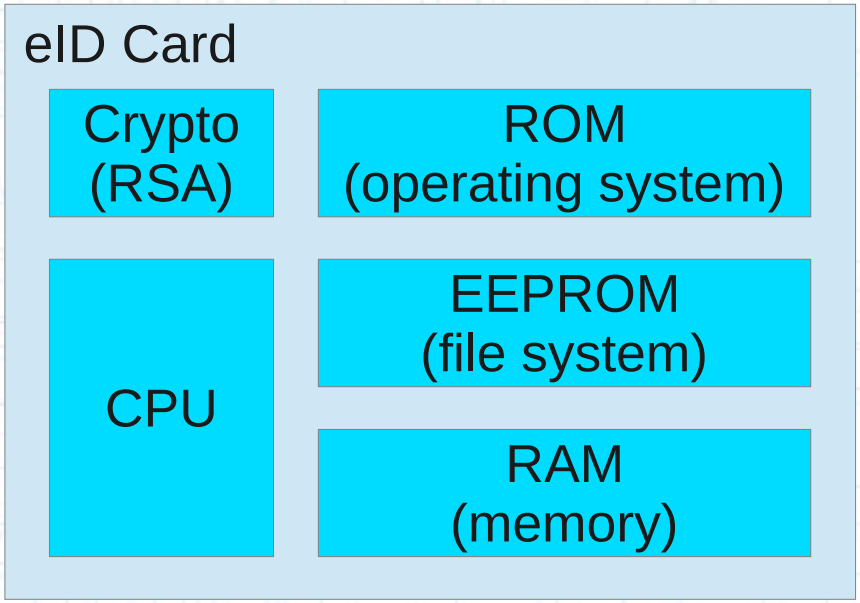
- Overview eID
- Cryptography in Java via JCA
- RSA, PKI, jTrust, eID Trust Service
- Integration levels for eID
- eID Applet
- Commons eID
- eID Identity Provider
- eID Digital Signature Service

eID Functionality

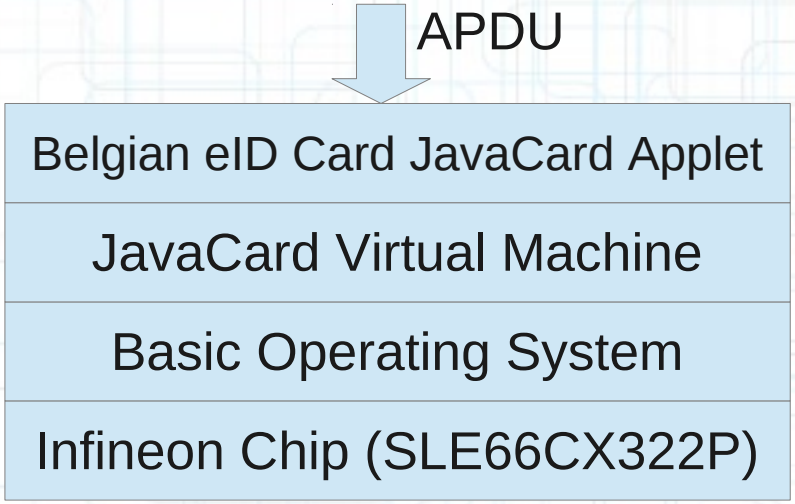
- Identification
  - Who are you?
- Authentication
  - Can you prove who you are?
- Digital signatures
  - Proof of statement made in time

The Belgian eID Card

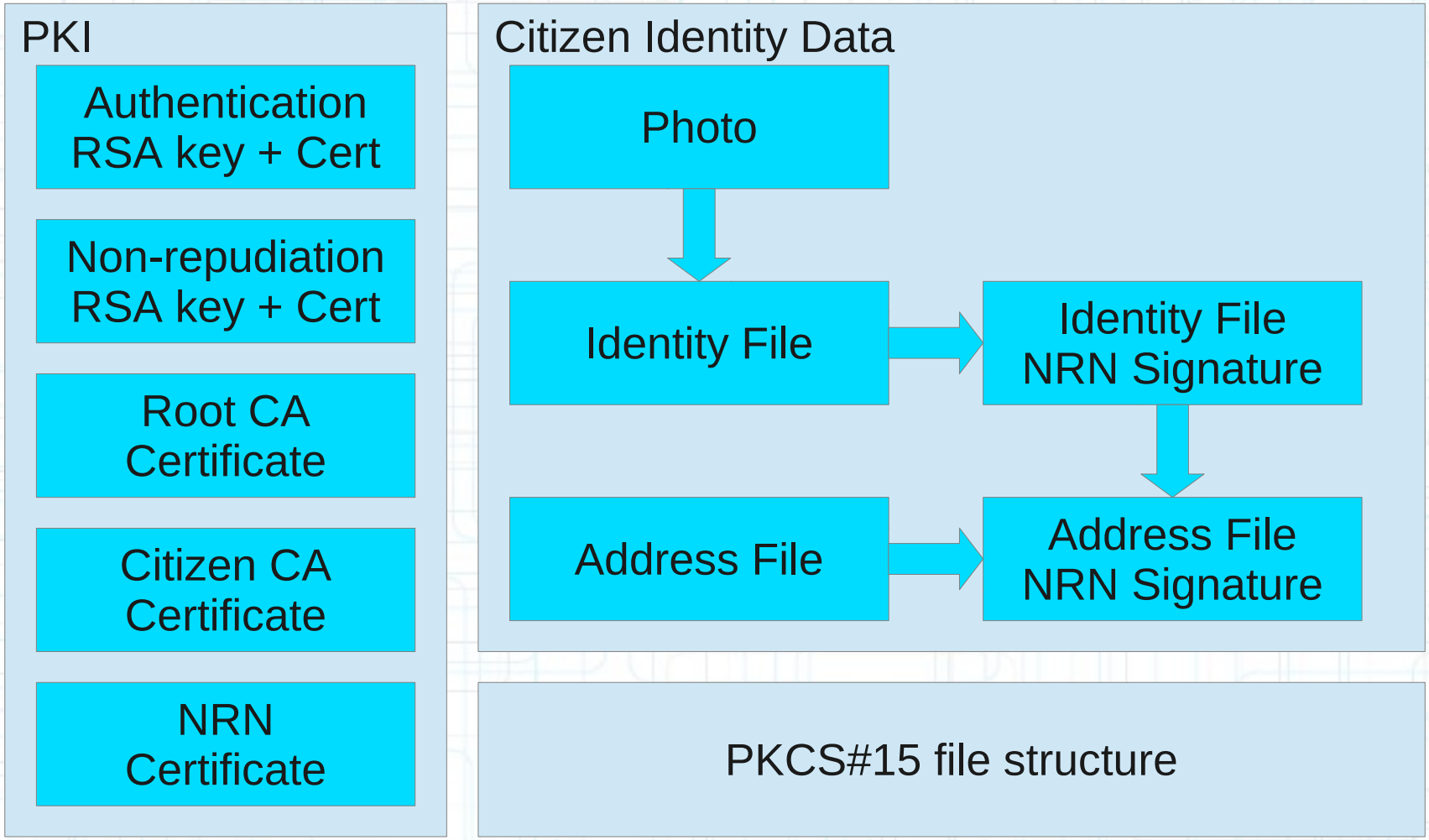
Physical Structure



Logical Structure



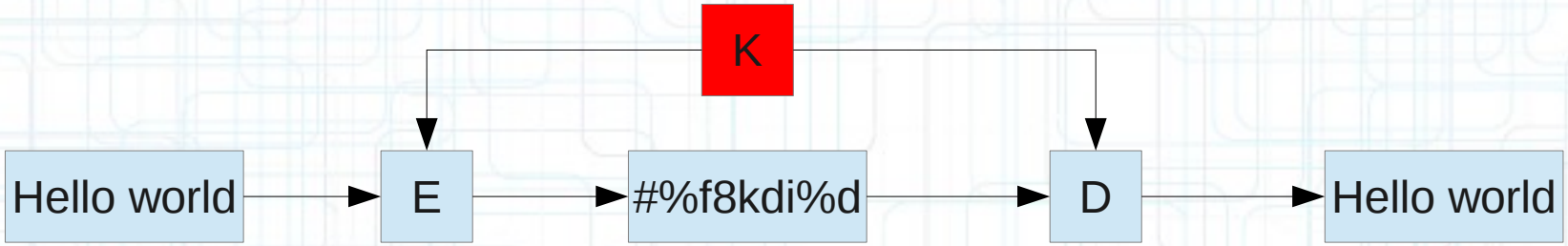
eID Card Content



Cryptography

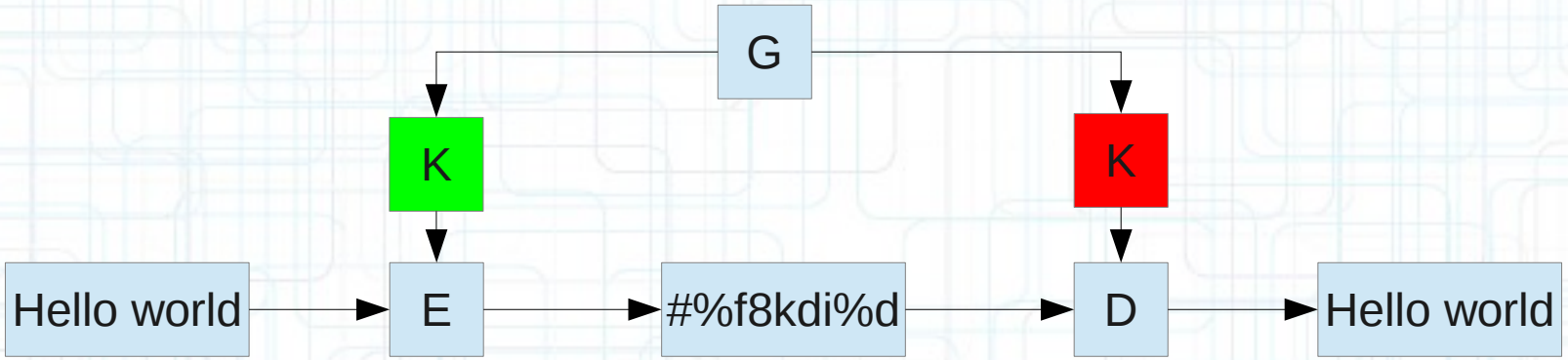
- Encryption/decryption
  - Symmetric: AES
  - Asymmetric: RSA
- Digital signatures
  - RSA
- Hash functions
  - SHA256
- MAC
- Threshold crypto
- ...

Symmetric encryption



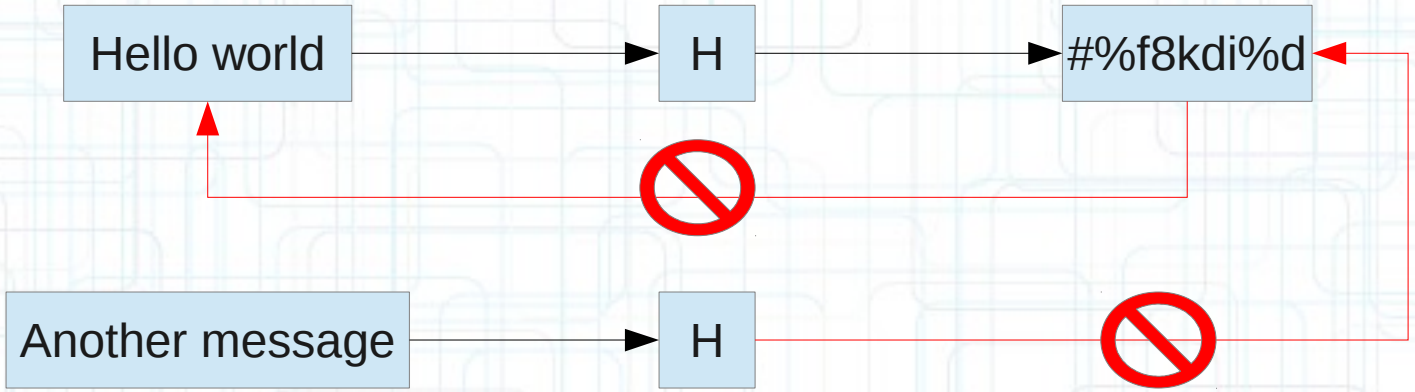

```
KeyGenerator keyGenerator = KeyGenerator.getInstance("AES");
keyGenerator.init(128);
SecretKey secretKey = keyGenerator.generateKey();

byte[] message = "hello world".getBytes();

Cipher cipher = Cipher.getInstance("AES");
cipher.init(Cipher.ENCRYPT_MODE, secretKey);
byte[] encryptedMessage = cipher.doFinal(message);

cipher.init(Cipher.DECRYPT_MODE, secretKey);
byte[] result = cipher.doFinal(encryptedMessage);
```

Asymmetric encryption



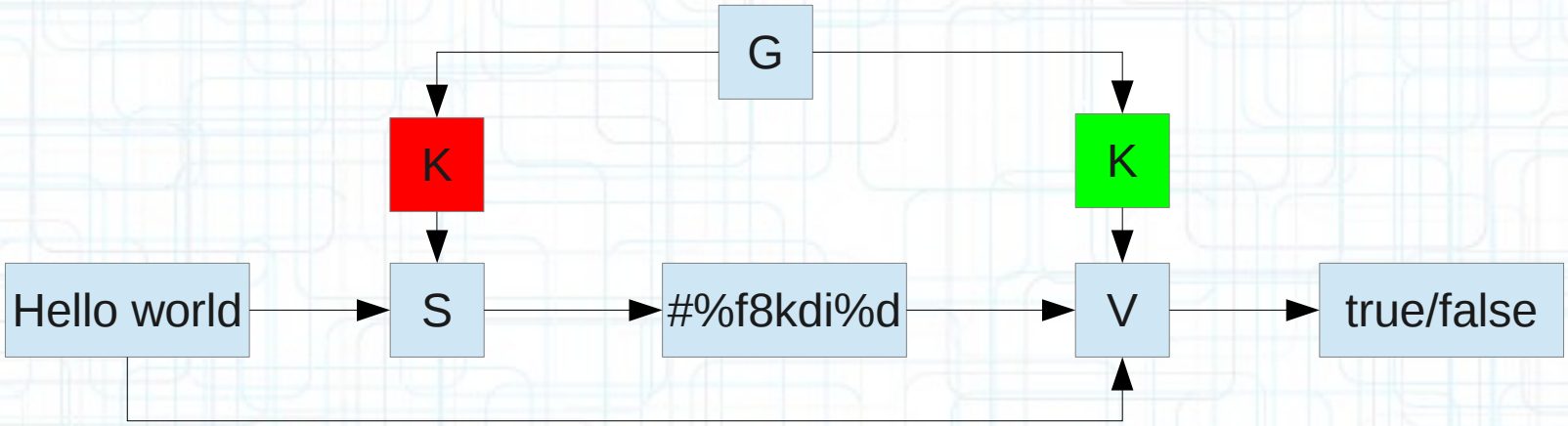

```
KeyPairGenerator keyPairGenerator =
      KeyPairGenerator.getInstance("RSA");
keyPairGenerator.initialize(1024);
KeyPair keyPair = keyPairGenerator.genKeyPair();

byte[] message = "hello world".getBytes();

Cipher cipher = Cipher.getInstance("RSA");
cipher.init(Cipher.ENCRYPT_MODE, keyPair.getPublic());
byte[] encryptedMessage = cipher.doFinal(message);

cipher.init(Cipher.DECRYPT_MODE, keyPair.getPrivate());
byte[] result = cipher.doFinal(encryptedMessage);
```

Hash Functions




```
byte[] message = "hello world".getBytes();

MessageDigest messageDigest =
     MessageDigest.getInstance("SHA256");
messageDigest.update(message);
byte[] result = messageDigest.digest();
```

Digital Signatures




```
KeyPairGenerator keyPairGenerator = KeyPairGenerator.getInstance("RSA");
keyPairGenerator.initialize(1024);
KeyPair keyPair = keyPairGenerator.genKeyPair();

byte[] message = "hello world".getBytes();

Signature signature = Signature.getInstance("SHA1withRSA");
signature.initSign(keyPair.getPrivate());
signature.update(message);
byte[] signatureValue = signature.sign();

signature.initVerify(keyPair.getPublic());
signature.update(message);
boolean result = signature.verify(signatureValue);
```

RSA

$$\text{group}\langle G,\circ\rangle:\forall a\in G:a^{|G|}=e_G\Rightarrow a^{t|G|+1}=a$$

$$n=pq\quad(\text{Miller-Rabin})$$

$$\mathbb{Z}_n^*=\{a\in\mathbb{Z}_n:a\perp n\}\text{ is a group}$$

$$|\mathbb{Z}_n^*|=\varphi(n)=(p-1)(q-1)$$

$$e\perp\varphi(n)\Rightarrow\exists d:ed\equiv 1\pmod{\varphi(n)}$$

$$\text{public key}:K^+=\langle e,n\rangle$$

$$\text{private key}:K^-=\langle d,n\rangle$$

$$\forall a\in\mathbb{Z}_n^*:c\equiv a^e\pmod n$$

$$\Rightarrow c^d\equiv(a^e)^d\equiv a^{t\varphi(n)+1}\equiv a\pmod n$$

$$\text{with cipher text } c$$

PKCS#1

- Textbook RSA has some problems:
  - Common modulus
  - Blinding
  - Low public exponent
- PKCS#1 introduces padding, ...
- 00 01 ff ff ff ... ff ff ff 00 DigestInfo(OID, #)

```
RSAPublicKey publicKey = (RSAPublicKey)
   certificate.getPublicKey();
BigInteger signatureValueBigInteger = new
   BigInteger(signatureValue);
BigInteger messageBigInteger =
   signatureValueBigInteger.modPow(
   publicKey.getPublicExponent(),
   publicKey.getModulus());
```

$$c^e \pmod n$$

ASN.1 & DER

- Abstract Syntax Notation One

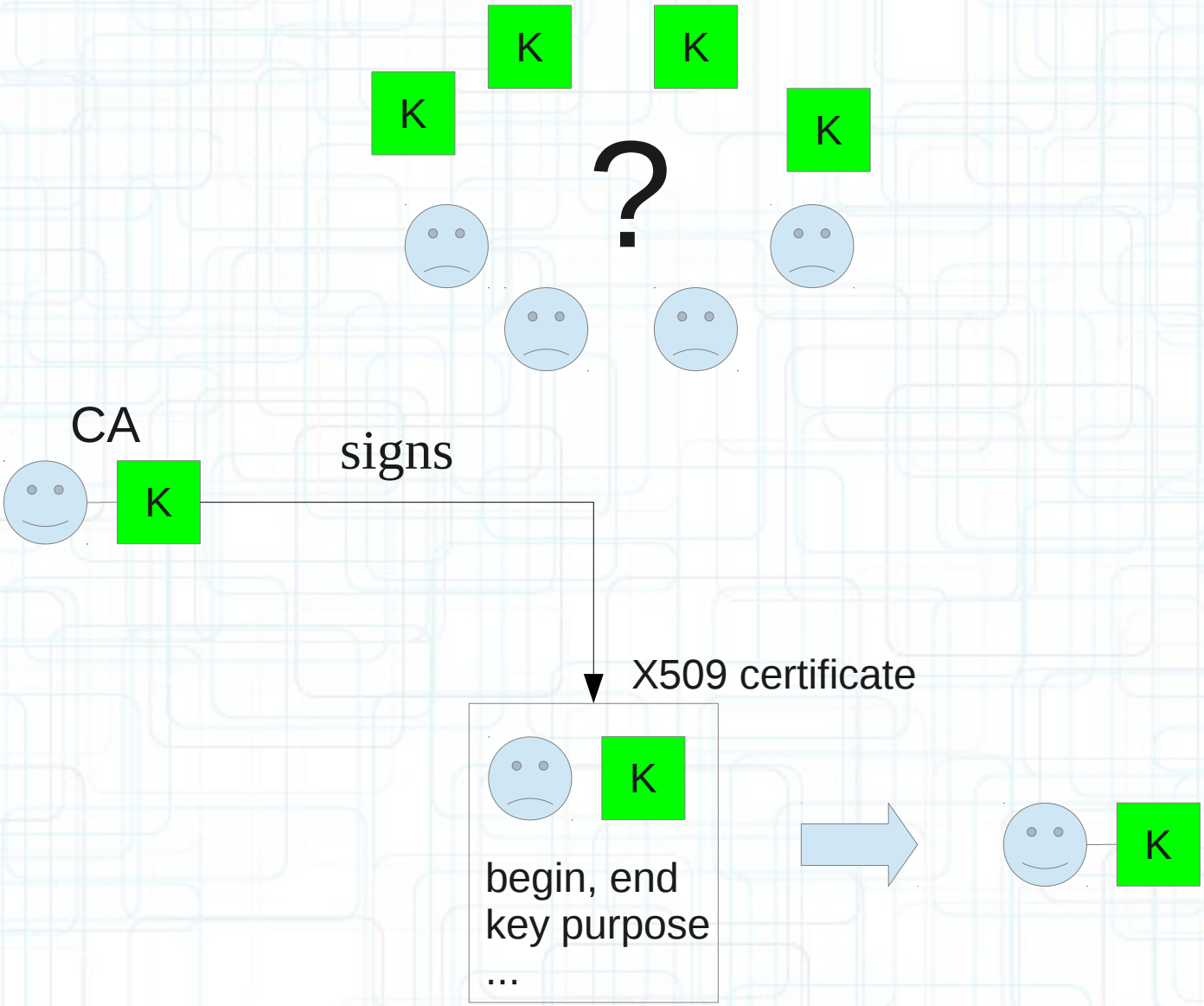
```
FullName ::= SEQUENCE {
   Name IA5String
   GivenName IA5String
}
```

- Distinguished Encoding Rules

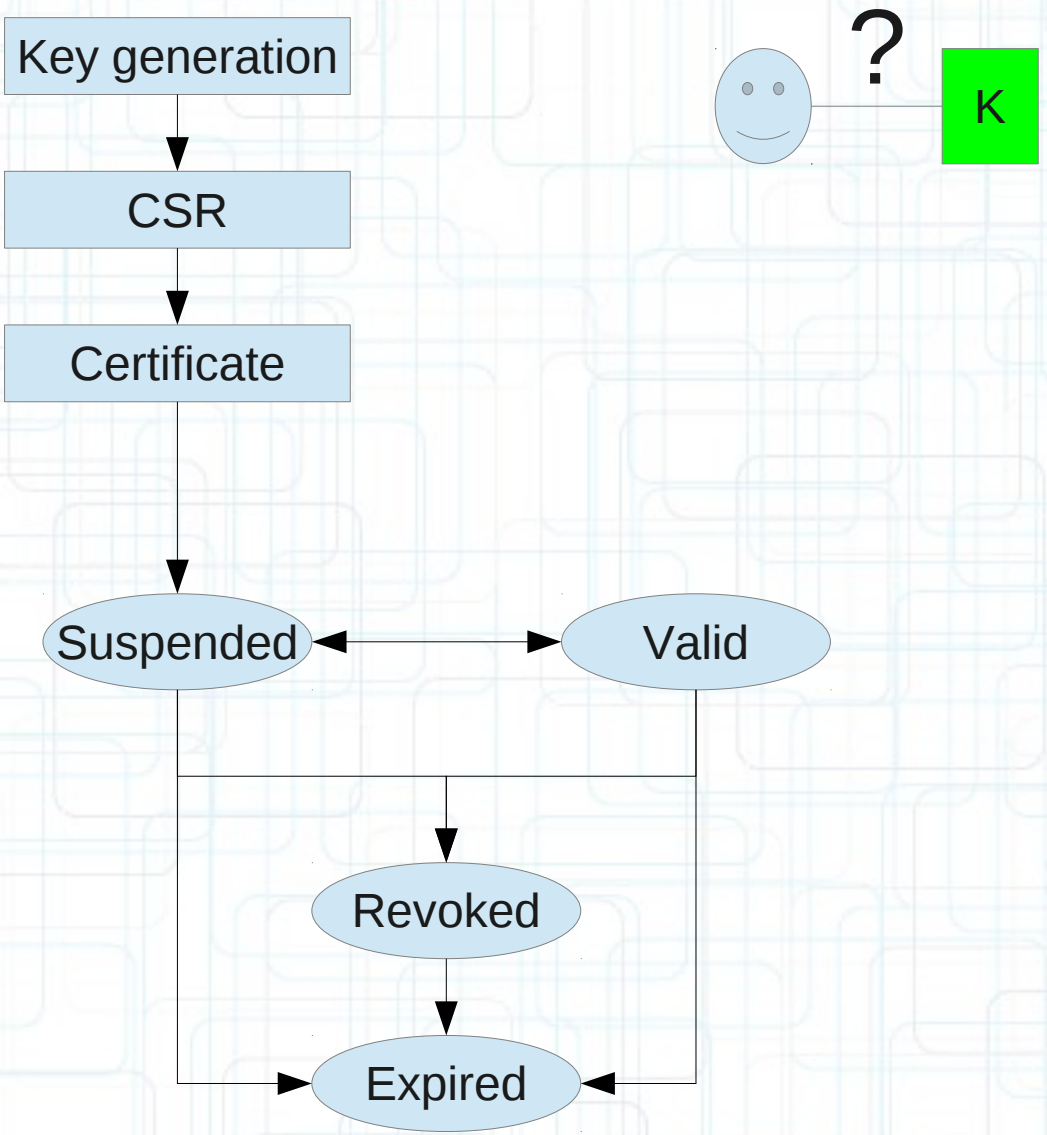
```
30 0a 16 3 “f” “o” “o” 16 3 “b” “a” “r”
```

- Implementation: BouncyCastle

PKI



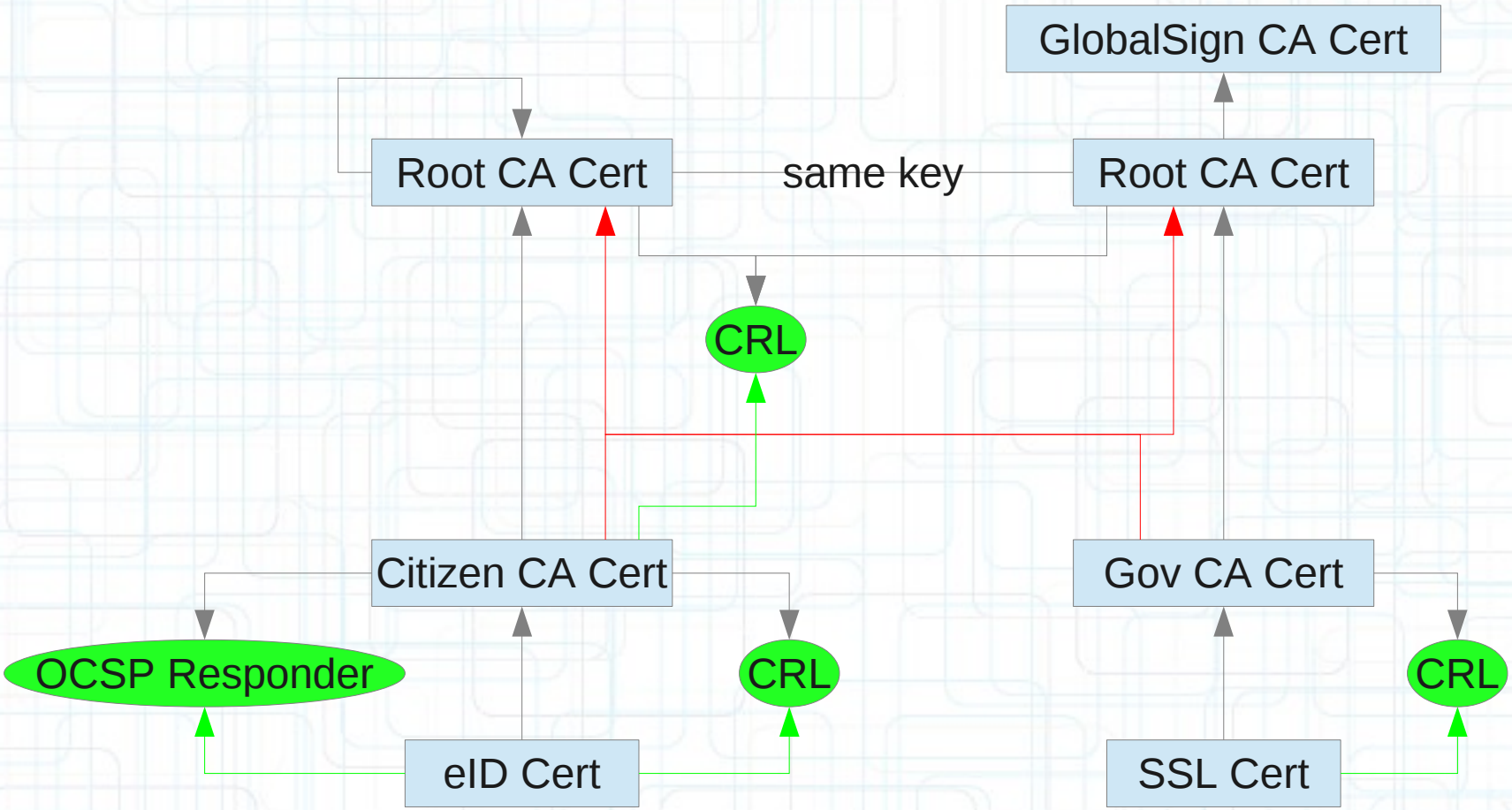
Certificate Life Cycle



Certificate Status

- CRL: Certificate Revocation List
  - Contains serial numbers of revoked certs
  - Signed by the CA
  - Issued periodically
- Online Certificate Status Protocol
  - Online query for certificate status
  - Signed by the CA OCSP Responder

eID PKI Infrastructure

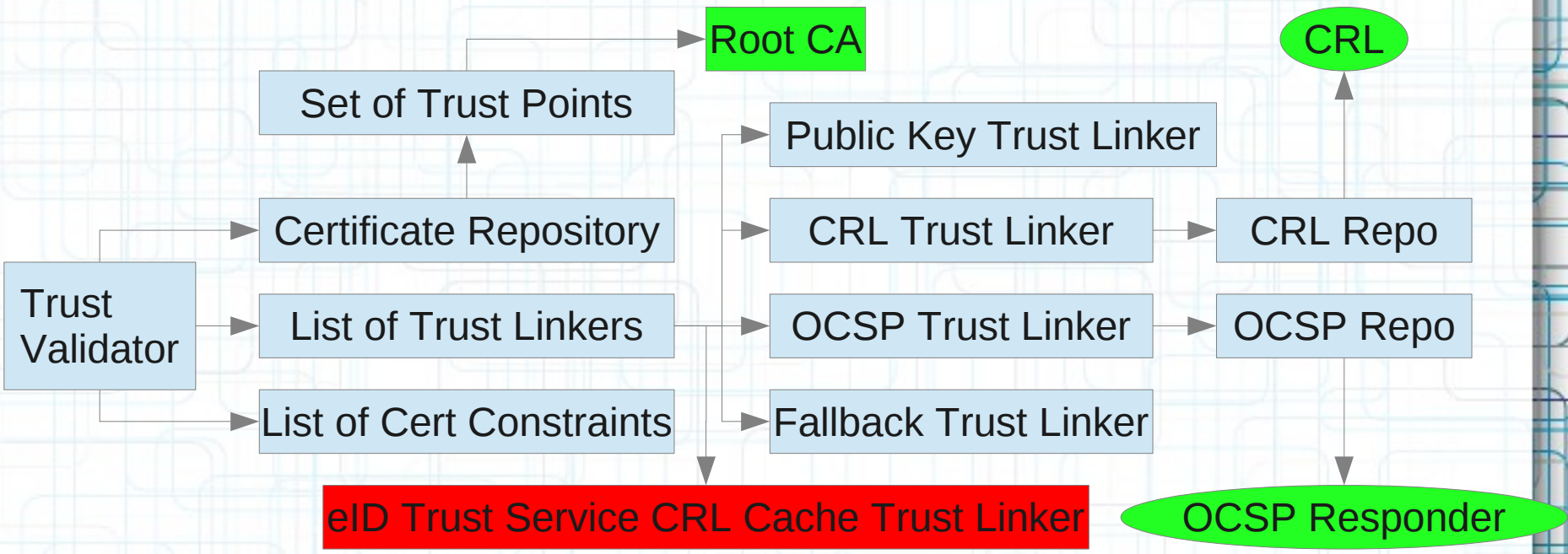


X509 Validation: jTrust

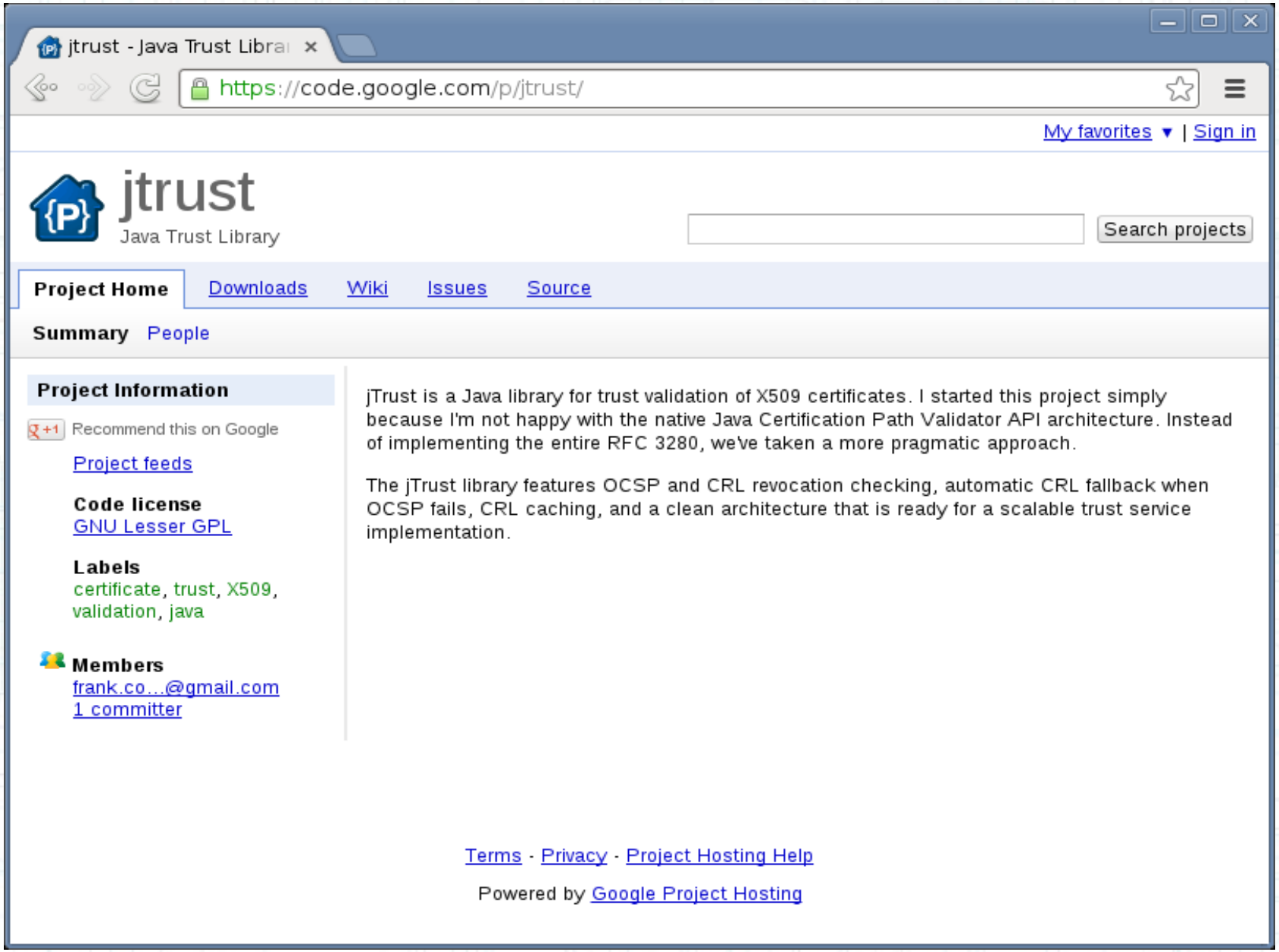
- Alternative to Java Cert Path API
- Java library with flexible architecture
- Readable code

```
Certificate[] authnCertificateChain = ...

Security.addProvider(new BouncyCastleProvider());

TrustValidator trustValidator =
BelgianTrustValidatorFactory.createTrustValidator();

trustValidator.isTrusted(authnCertificateChain);
```

jTrust Architecture



X509 Validation: jTrust

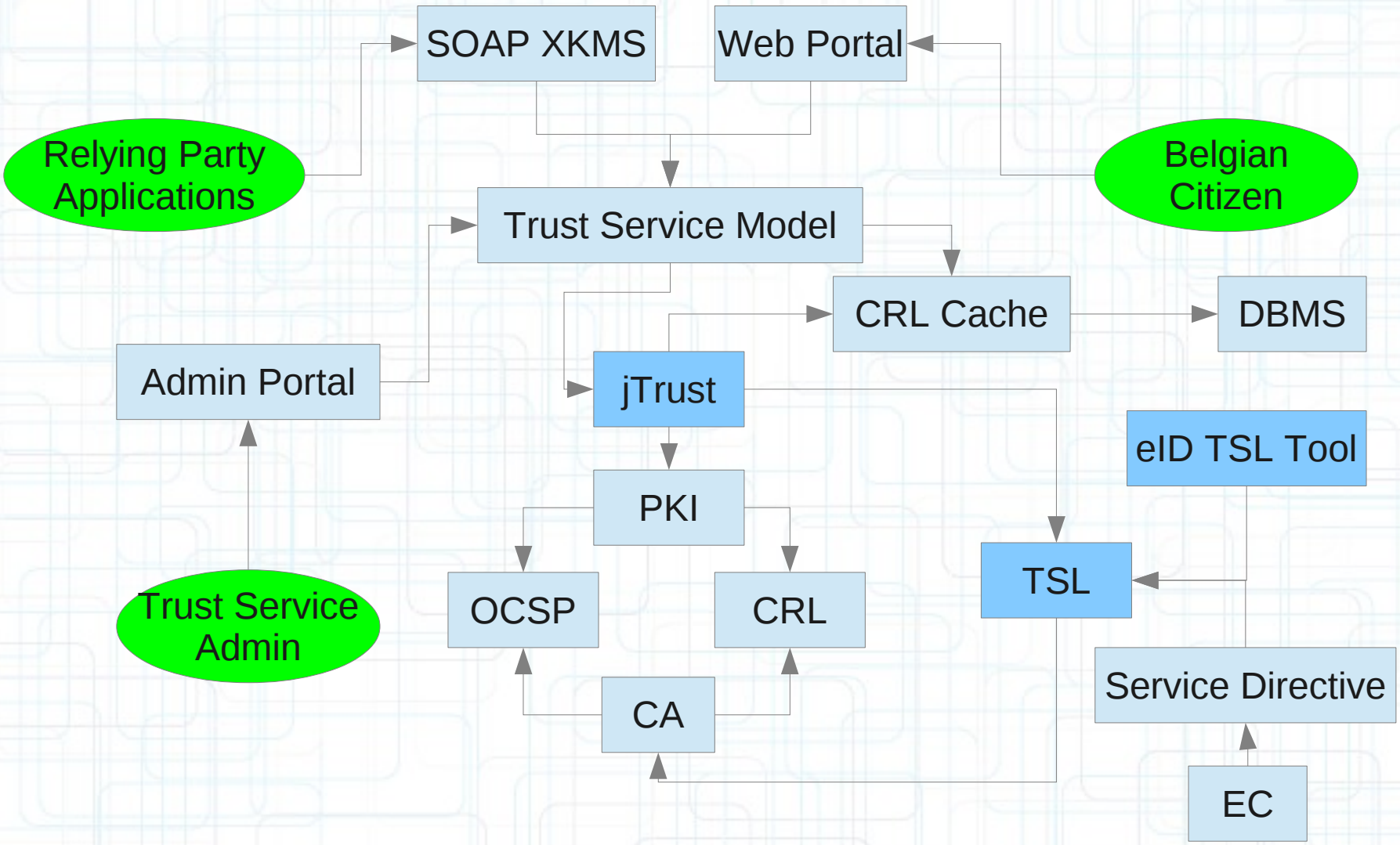


X509 Validation: Trust Service

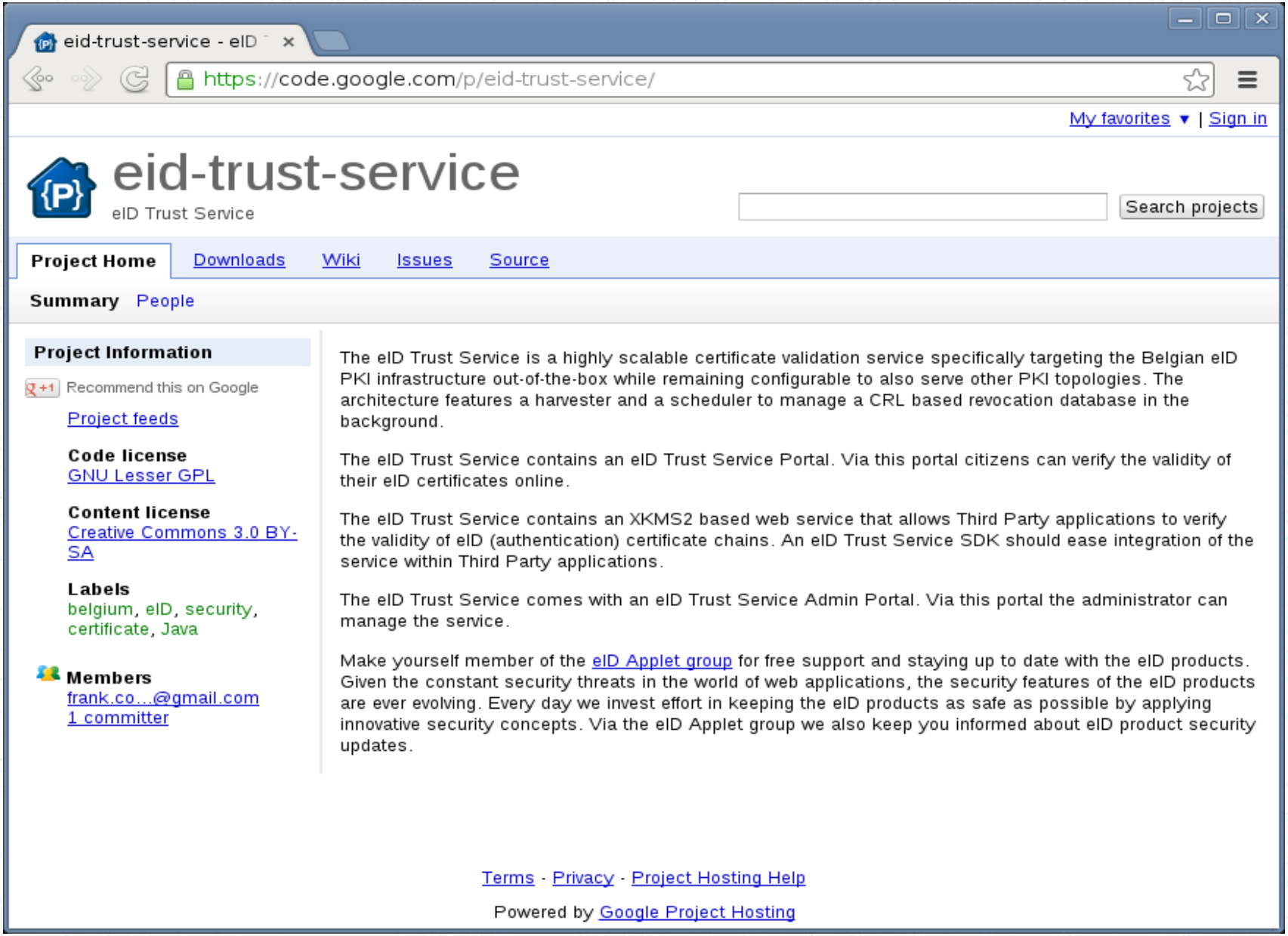
- jTrust extension: CRL cache (Java EE)
- XKMS2 web service interface
- Java SDK

```
List<X509Certificate> authnCertificateChain = ...

XKMS2Client client = new XKMS2Client(
"https://www.e-contract.be/eid-trust-service-ws/xkms2");

client.validate("BE-AUTH", authnCertificateChain);
```

eID Trust Service Architecture

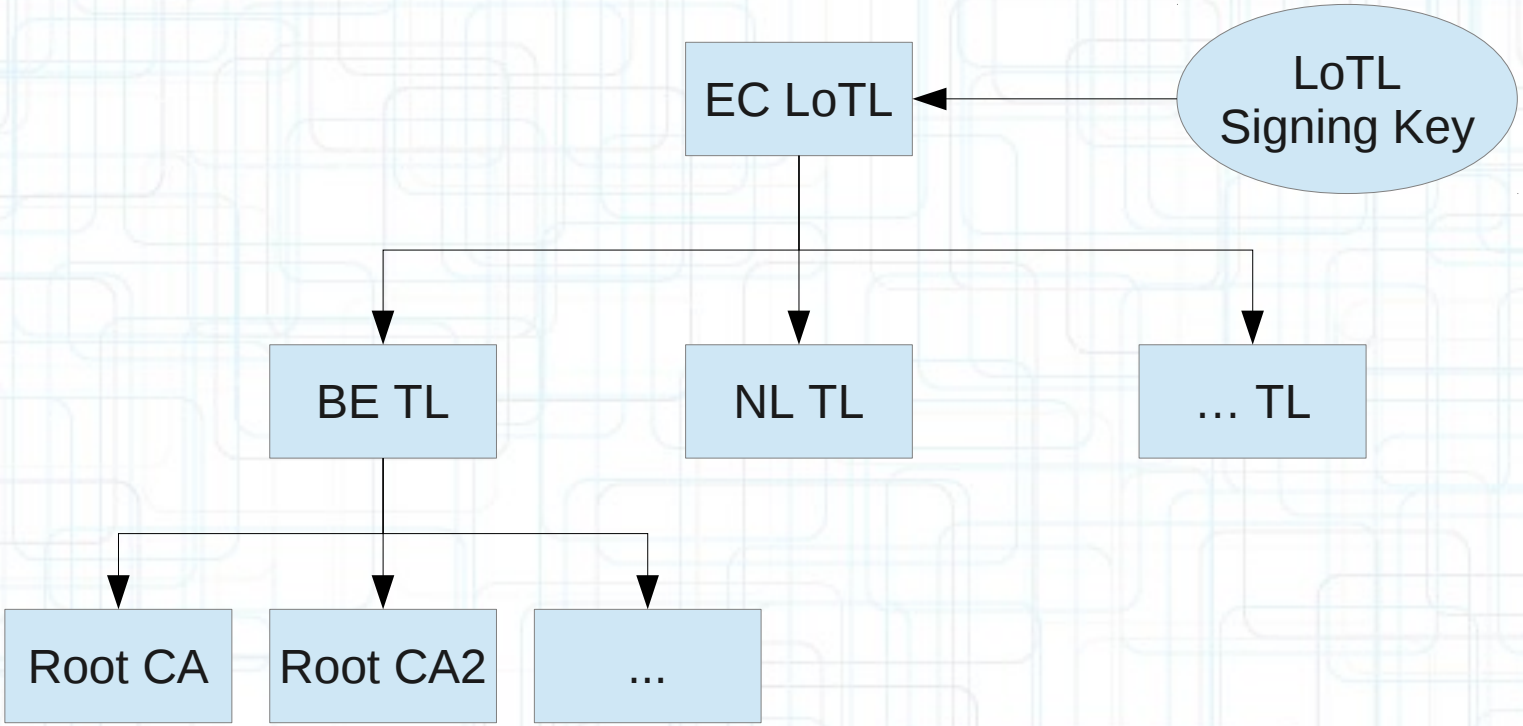


X509 Validation: Trust Service

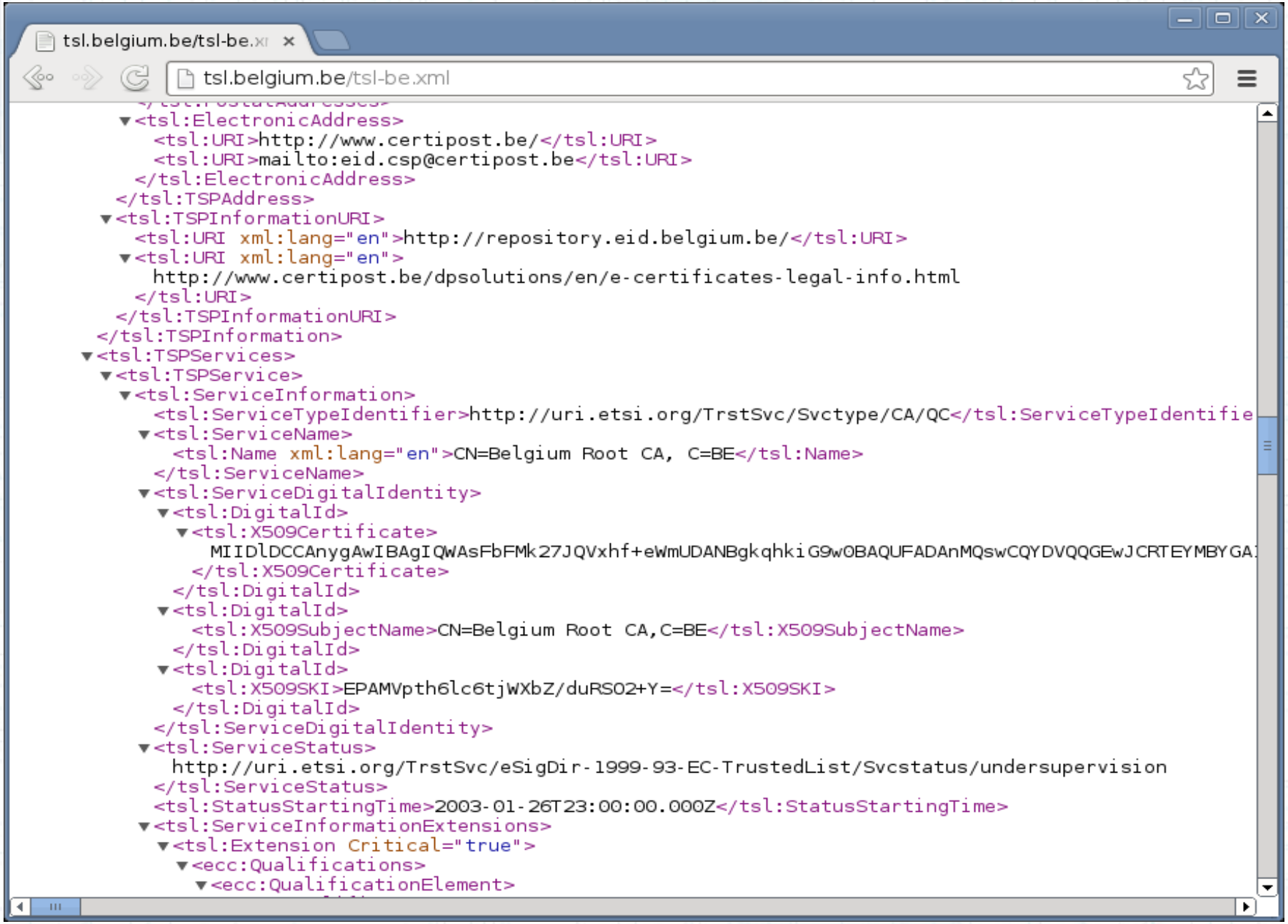


Bootstrapping Trust

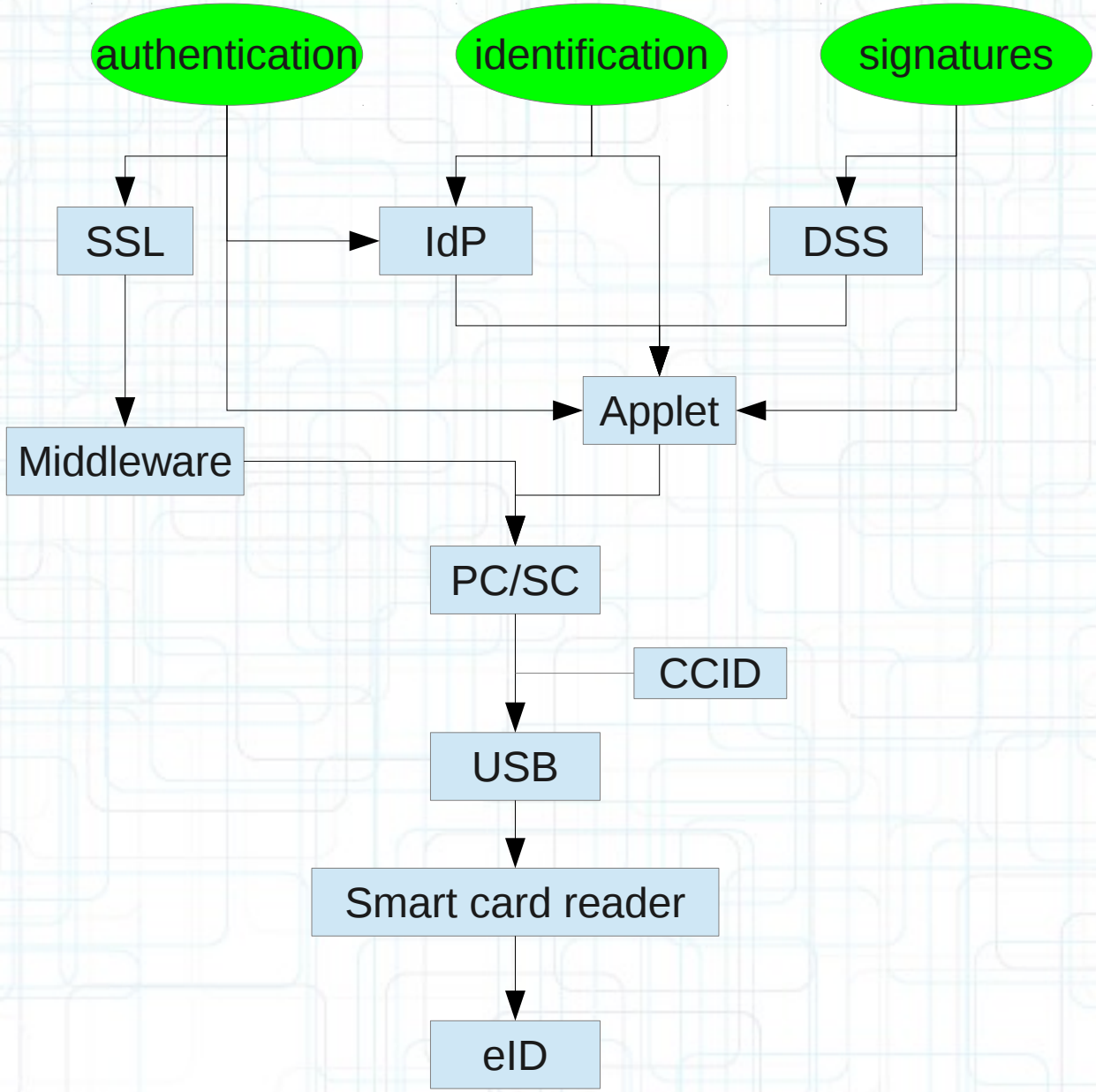
- Trusted Lists & List of Trusted Lists (LoTL)
- Dynamic updating of the EU trust realm
- Bootstrapping reduced to a single key



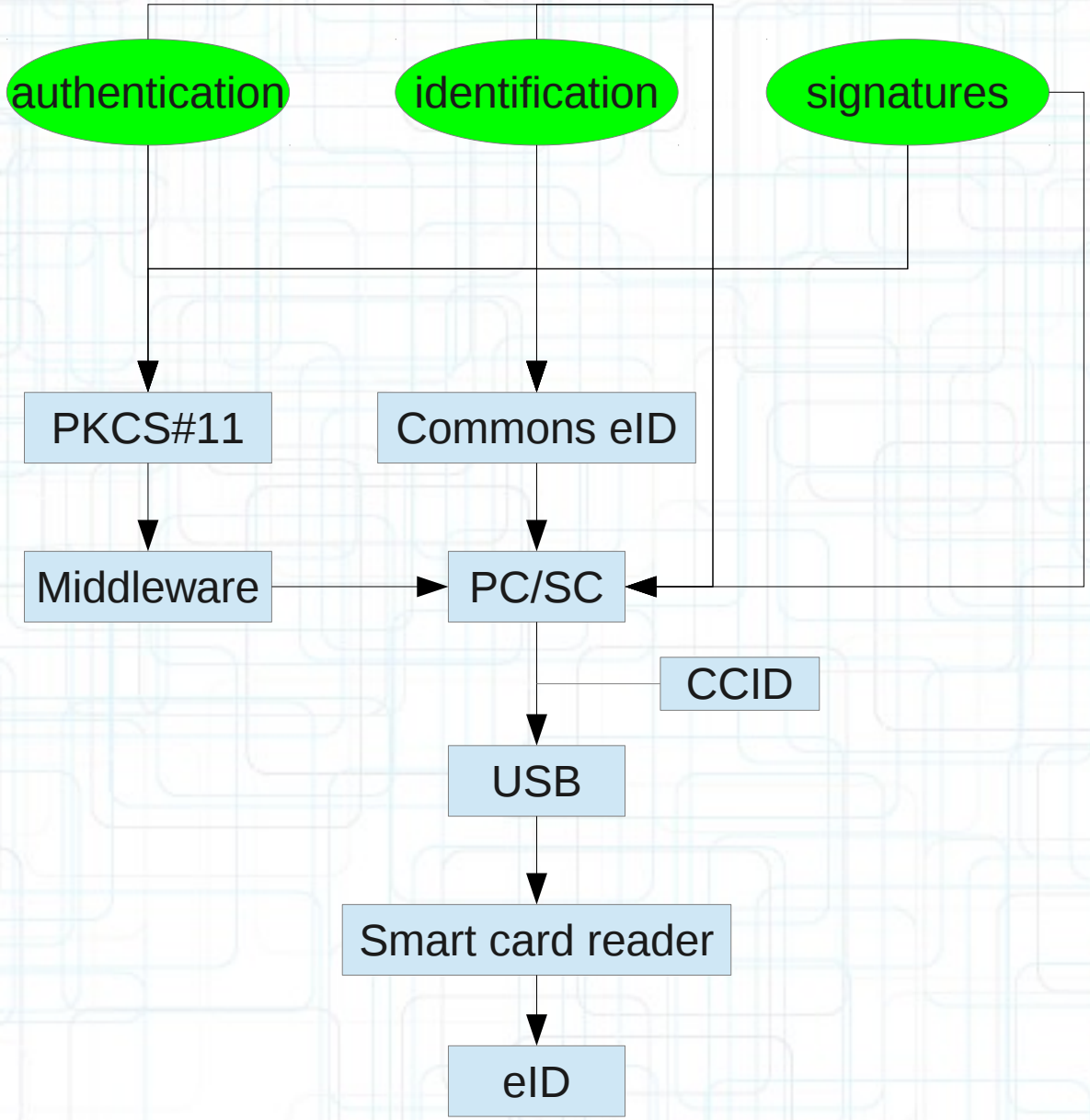
Trusted List Belgium



eID Web Integration



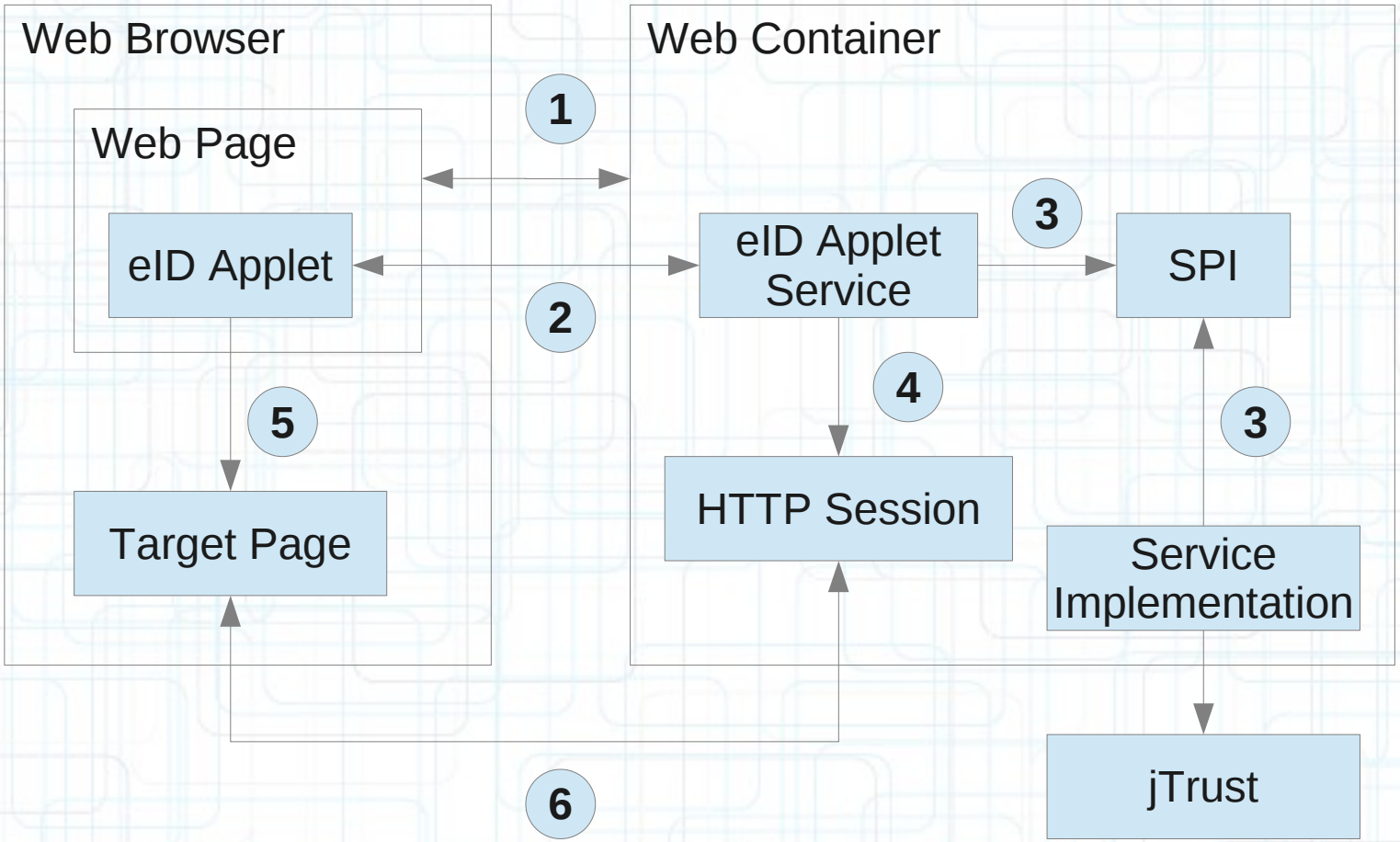
eID Desktop Integration



PC/SC

```
TerminalFactory terminalFactory = TerminalFactory.getDefault();
CardTerminals cardTerminals = terminalFactory.terminals();
CardTerminal cardTerminal = cardTerminals.list().get(0);
Card card = cardTerminal.connect("T=0");
CardChannel cardChannel = card.getBasicChannel();

// select file
cardChannel.transmit(new CommandAPDU(0x00, 0xA4, 0x08, 0x0C,
    new byte[] { 0x3F, 0x00, (byte) 0xDF, 0x01, 0x40, 0x35 }));

ByteArrayOutputStream baos = new ByteArrayOutputStream();
int offset = 0;
ResponseAPDU responseApdu;
do {
  // read binary
  responseApdu = cardChannel.transmit(new CommandAPDU(0x00,
      0xB0, offset >> 8, offset & 0xFF, 0xff));
  baos.write(responseApdu.getData());
  offset += responseApdu.getData().length;
} while (responseApdu.getData().length == 0xff);

BufferedImage photo =
    ImageIO.read(new ByteArrayInputStream(baos.toByteArray()));
JOptionPane.showMessageDialog(null, new ImageIcon(photo));
```

eID Applet



- eID Applet Service targets Java EE servlet container only

eID Applet Example

identify-the-user.html

```
<script src="https://www.java.com/js/deployJava.js"></script>
<script>
	var attributes = {
		code :'be.fedict.eid.applet.Applet.class',
		archive :'eid-applet-package-1.1.0.Beta4.jar',
		width :600,
		height :300
	};
	var parameters = {
		TargetPage :'identification-result-page.jsp',
		AppletService :'applet-service',
	};
	var version = '1.6';
	deployJava.runApplet(attributes, parameters, version);
</script>
```

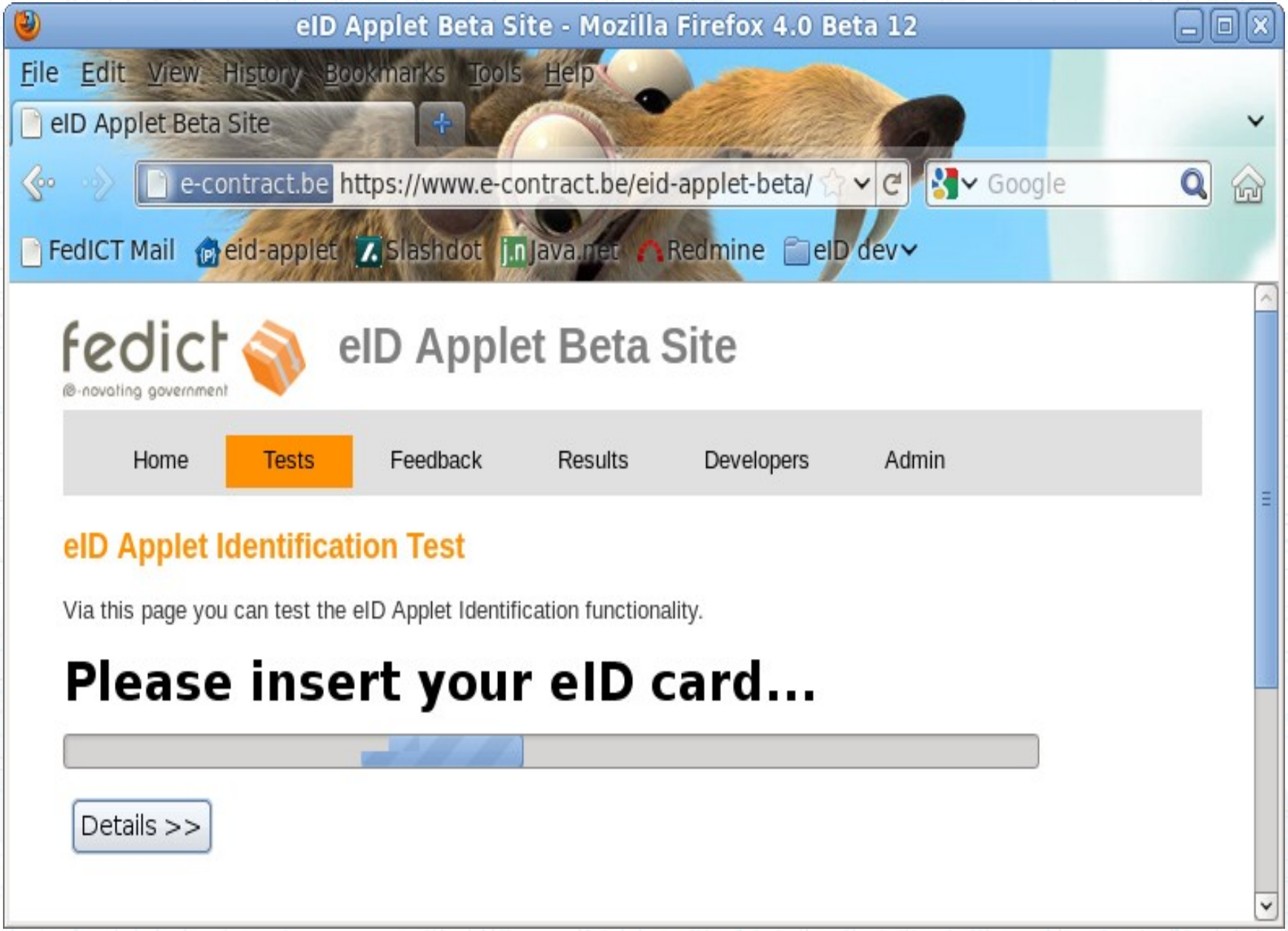
identification-result-page.jsp

```
<%@page import="be.fedict.eid.applet.service.Identity"%>
<html>
<body>
	<%=((Identity) session.getAttribute("eid.identity")).name%>
</body>
</html>
```

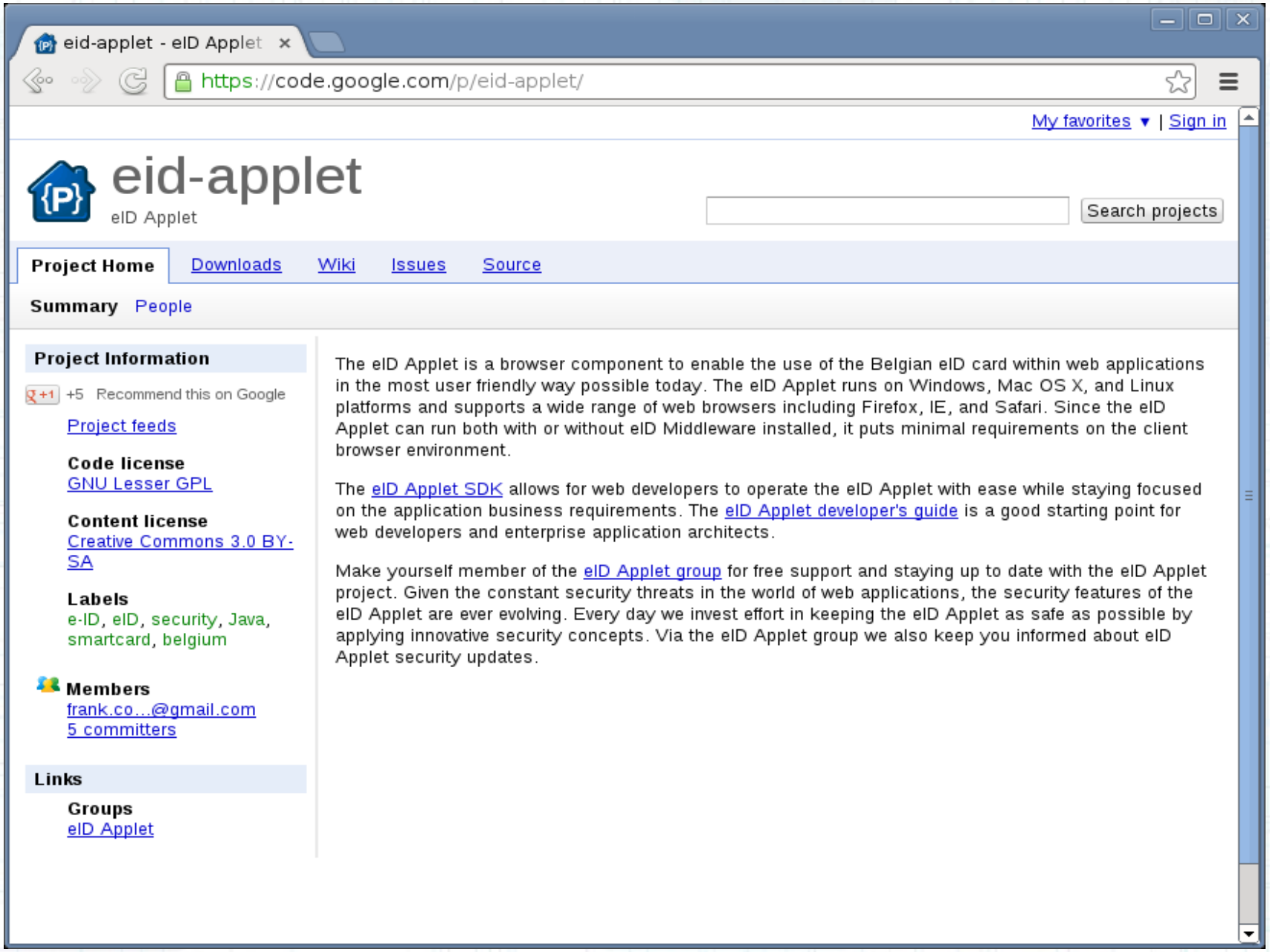
web.xml

```
<servlet>
	<servlet-name>AppletServiceServlet</servlet-name>
	<servlet-class>be.fedict.eid.applet.service.AppletServiceServlet</servlet-class>
</servlet>
<servlet-mapping>
	<servlet-name>AppletServiceServlet</servlet-name>
	<url-pattern>/applet-service</url-pattern>
</servlet-mapping>
```

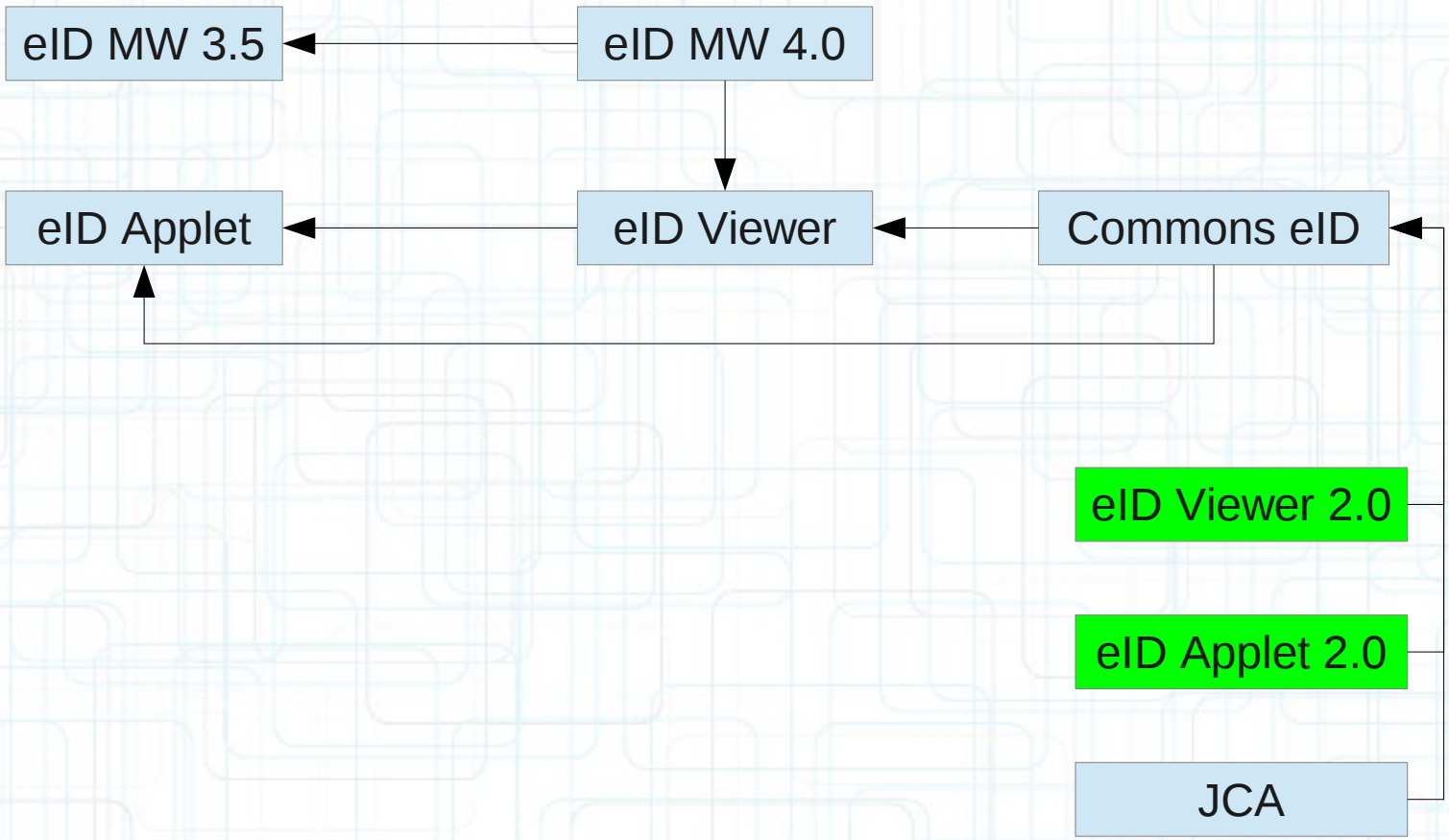
eID Applet


eID Applet Beta Site - Mozilla Firefox 4.0 Beta 12
File Edit View History Bookmarks Tools Help
eID Applet Beta Site
e-contract.be https://www.e-contract.be/eid-applet-beta/
Google
FedICT Mail
eid-applet
Slashdot
Java.net
Redmine
eID dev
fedict
e-novating government
eID Applet Beta Site
Home
Tests
Feedback
Results
Developers
Admin
eID Applet Identification Test
Via this page you can test the eID Applet Identification functionality.
Please insert your eID card...
Details >>

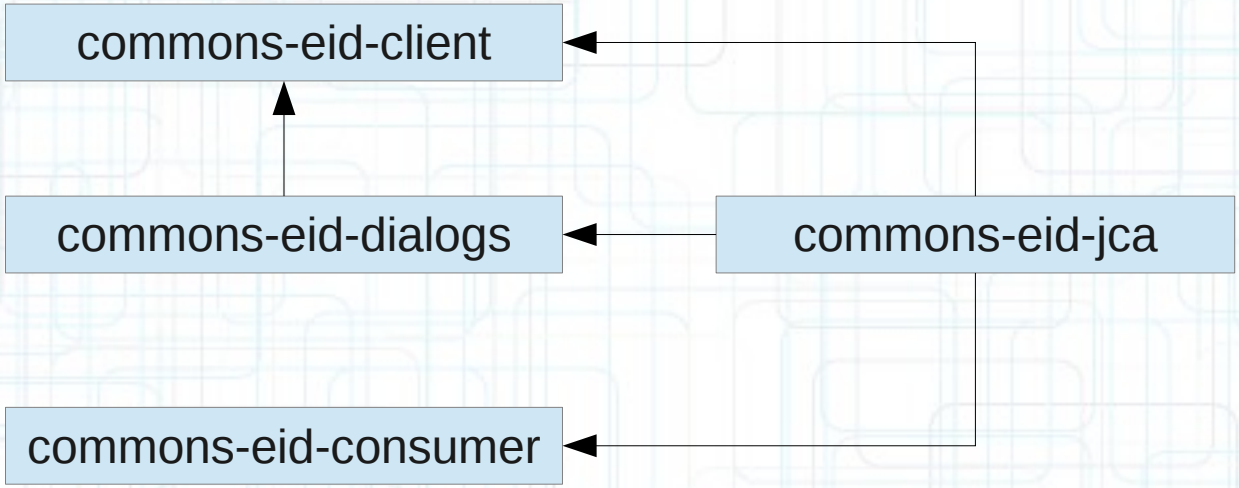
eID Applet


eid-applet - eID Applet
https://code.google.com/p/eid-applet/
My favorites | Sign in
eid-applet
eID Applet
Search projects
Project Home
Downloads
Wiki
Issues
Source
Summary
People
Project Information
+5 Recommend this on Google
Project feeds
Code license
GNU Lesser GPL
Content license
Creative Commons 3.0 BY-SA
Labels
e-ID, eID, security, Java, smartcard, belgium
Members
frank.co...@gmail.com
5 committers
Links
Groups
eID Applet
The eID Applet is a browser component to enable the use of the Belgian eID card within web applications in the most user friendly way possible today. The eID Applet runs on Windows, Mac OS X, and Linux platforms and supports a wide range of web browsers including Firefox, IE, and Safari. Since the eID Applet can run both with or without eID Middleware installed, it puts minimal requirements on the client browser environment.
The eID Applet SDK allows for web developers to operate the eID Applet with ease while staying focused on the application business requirements. The eID Applet developer's guide is a good starting point for web developers and enterprise application architects.
Make yourself member of the eID Applet group for free support and staying up to date with the eID Applet project. Given the constant security threats in the world of web applications, the security features of the eID Applet are ever evolving. Every day we invest effort in keeping the eID Applet as safe as possible by applying innovative security concepts. Via the eID Applet group we also keep you informed about eID Applet security updates.

Commons eID


eID MW 3.5
eID MW 4.0
eID Applet
eID Viewer
Commons eID
eID Viewer 2.0
eID Applet 2.0
JCA

Commons eID Components



- Desktop: commons-eid-jca, or lower-level
- Client-Server:
  - Client: commons-eid-client, dialogs
  - Server: commons-eid-consumer

BeID JCA Security Provider

- KeyStore
  - Load key material
- Signature
  - Targeting eID key material
- SecureRandom
  - eID based hardware secure random
- X509KeyManager
  - eID based mutual SSL

```
Security.addProvider(new BeIDProvider());
```

JCA KeyStore

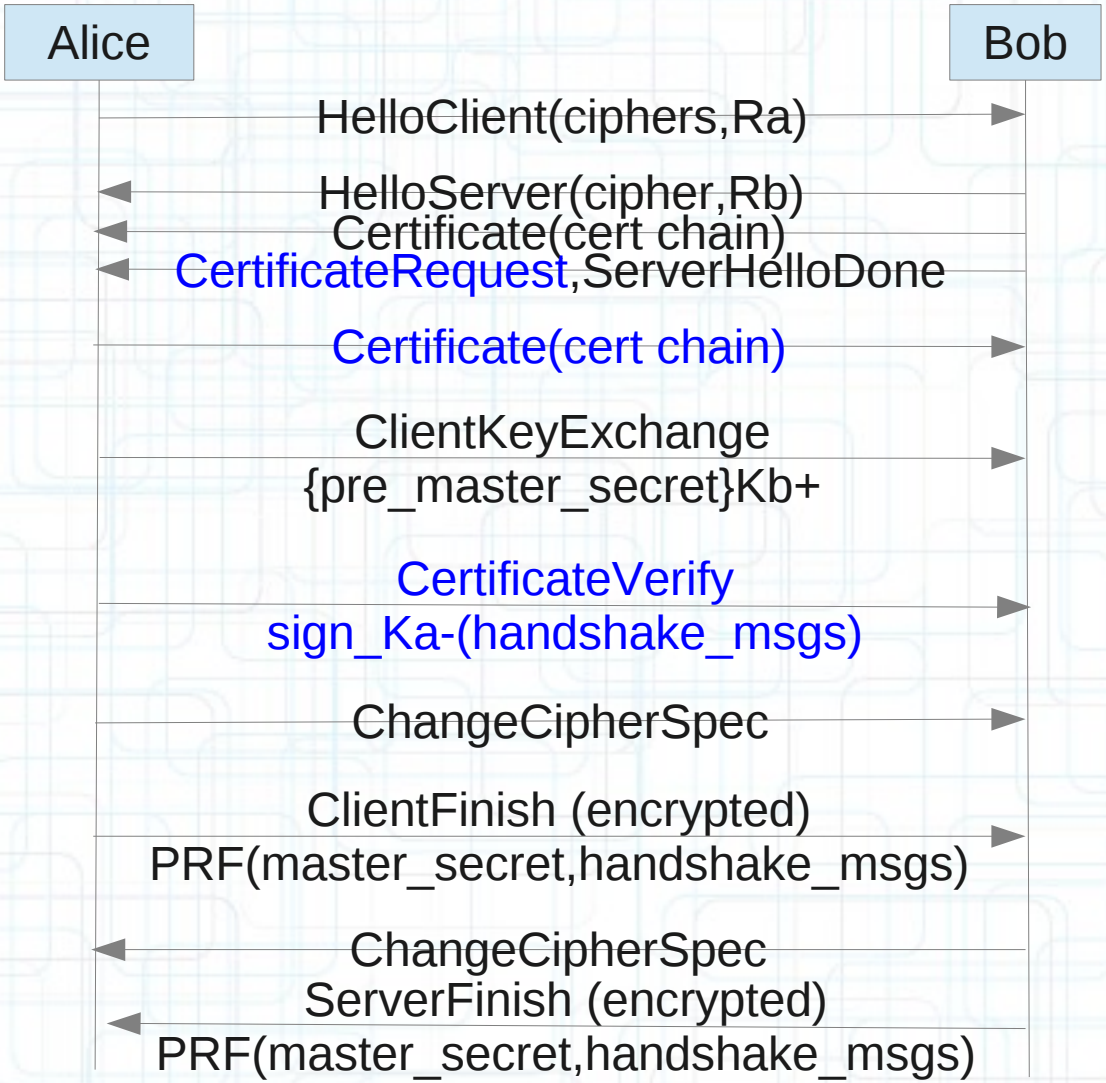
```
Security.addProvider(new BeIDProvider());

KeyStore keyStore = KeyStore.getInstance("BeID");
keyStore.load(null);

PrivateKeyEntry privateKeyEntry =
   (PrivateKeyEntry)
   keyStore.getEntry("Authentication", null);
PrivateKey privateKey =
   privateKeyEntry.getPrivateKey();

X509Certificate certificate = (X509Certificate)
   privateKeyEntry.getCertificate();
PublicKey publicKey = certificate.getPublicKey();
```

JCA Signatures

- Supported algorithms:
  - SHA 1/224/256/384/512
  - NONE
  - RIPEMD 128/160/256
- Delegate init: SupportedKeyClasses

```
Signature signature =
   Signature.getInstance("SHA256withRSA");
signature.initSign(privateKey);
assertTrue(signature.getProvider() instanceof
   BeIDProvider);

final byte[] toBeSigned =
   "hello world".getBytes();
signature.update(toBeSigned);
final byte[] signatureValue = signature.sign();
```

Mutual SSL



Ra: random by A
Rb: random by B
Kb+: public key of B
pre_master_secret: random by A
Ka-: private key of A
PRF: pseudo-random function

Commons eID: SSL

```
Security.addProvider(new BeIDProvider());
KeyManagerFactory keyManagerFactory =
   KeyManagerFactory.getInstance("BeID");

BeIDManagerFactoryParameters spec = new
   BeIDManagerFactoryParameters();
spec.setAutoRecovery(true);
spec.setCardReaderStickiness(true);
keyManagerFactory.init(spec);

SecureRandom secureRandom = new SecureRandom();
sslContext.init(
   keyManagerFactory.getKeyManagers(), null,
   secureRandom);

SSLSocketFactory sslSocketFactory =
   sslContext.getSocketFactory();
```

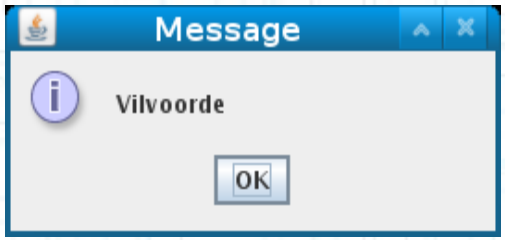
Commons eID Identification

- Via lower-level API:
  - Synchronous
  - Asynchronous: event driven

```
BeIDCards beIDCards = new BeIDCards();
BeIDCard beIDCard = beIDCards.getOneBeIDCard();

byte[] photoData =
    beIDCard.readFile(FileType.Photo);

BufferedImage photo = ImageIO.read(
    new ByteArrayInputStream(photoData));
JOptionPane.showMessageDialog(null,
    new ImageIcon(photo));
```

Commons eID: events

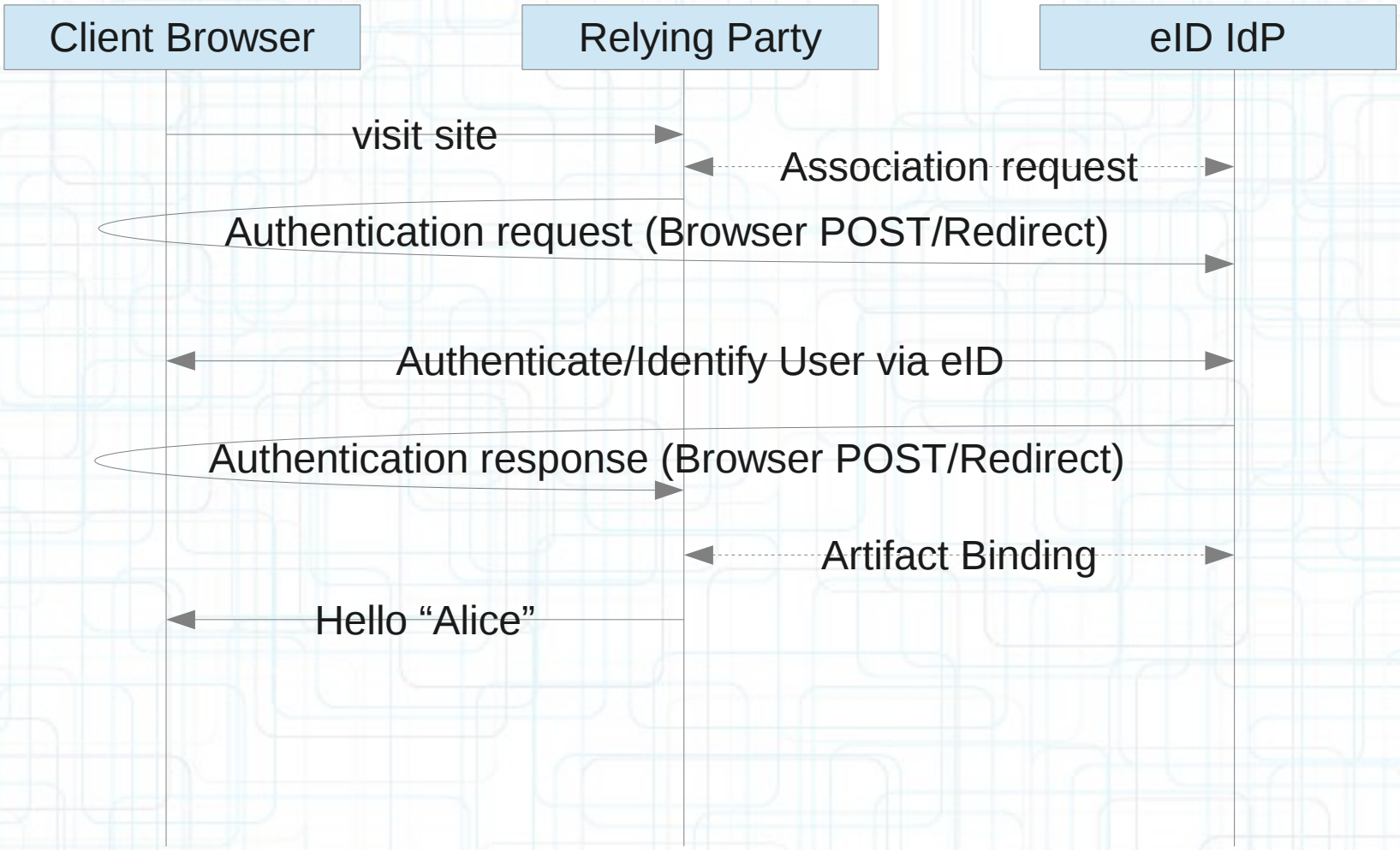
```
BeIDCardManager beIDCardManager = new BeIDCardManager();
final JLabel label = new JLabel();
beIDCardManager.addBeIDCardEventListener(new BeIDCardEventsListener() {
    @Override
    public void eIDCardRemoved(CardTerminal cardTerminal, BeIDCard card) {
        label.setText("insert card...");
    }

    @Override
    public void eIDCardInserted(CardTerminal cardTerminal, BeIDCard card) {
        try {
            Address address = TlvParser.parse(
                card.readFile(FileType.Address), Address.class);
            label.setText(address.municipality);
        } catch (Exception e) {
            label.setText("error");
        }
    }

    @Override
    public void eIDCardEventsInitialized() {
    }
});
beIDCardManager.start();
JOptionPane.showMessageDialog(null, label);
```



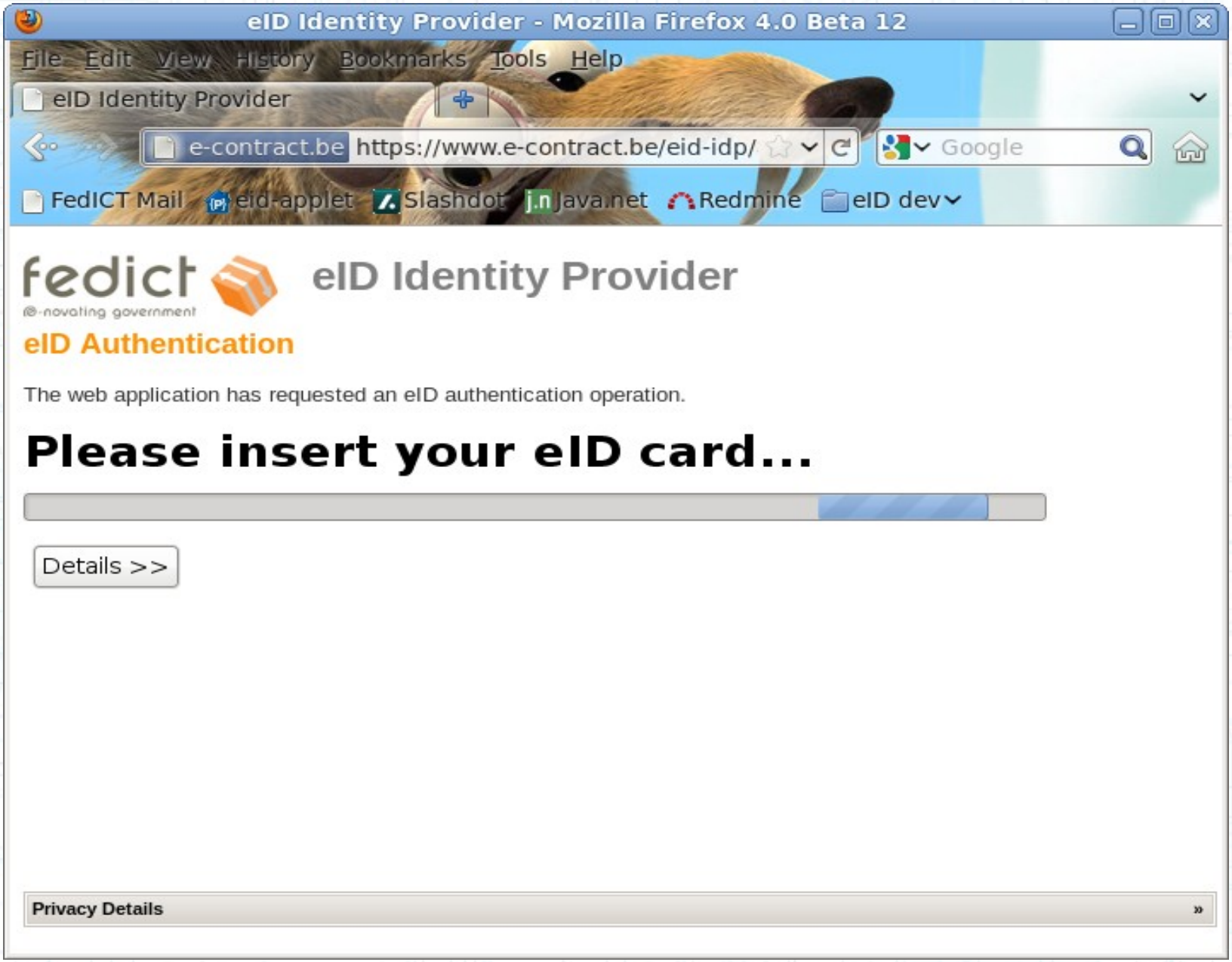
eID Identity Provider

- Supports different OPEN authentication protocols:
  - OpenID 2.0: PHP, Drupal, ...
  - SAML2 Browser POST: Java EE, ...
  - WS-Federation: ASP.NET, ...
- Offers 3 eID based flows:
  - Identification
  - Authentication
  - Identification combined with authentication
- Configurable Relying Parties via admin console
- Comes in JBoss AS 6.1 distributions:
  - MySQL, PostgreSQL, Oracle

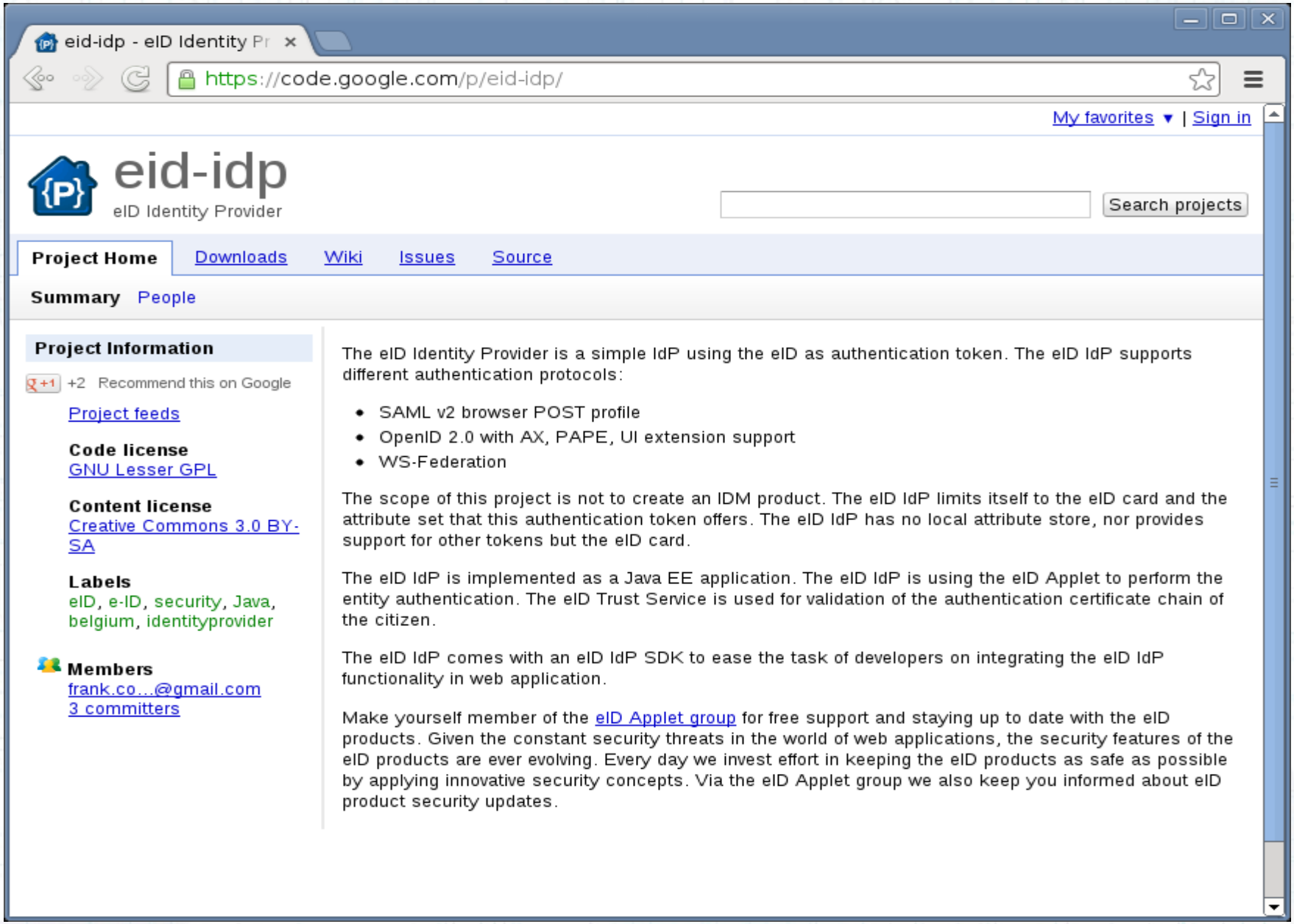
Authentication Protocols



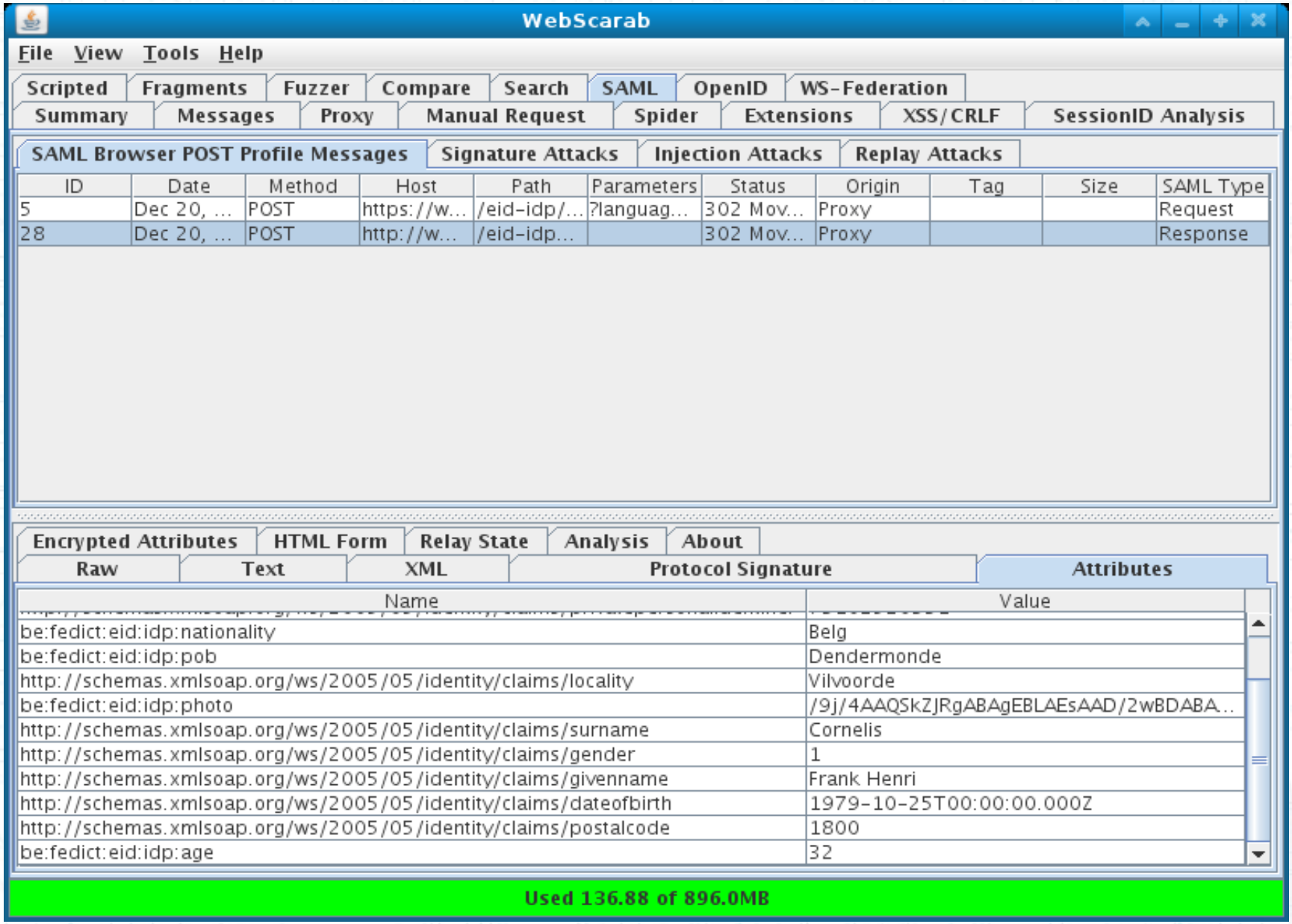
eID Identity Provider



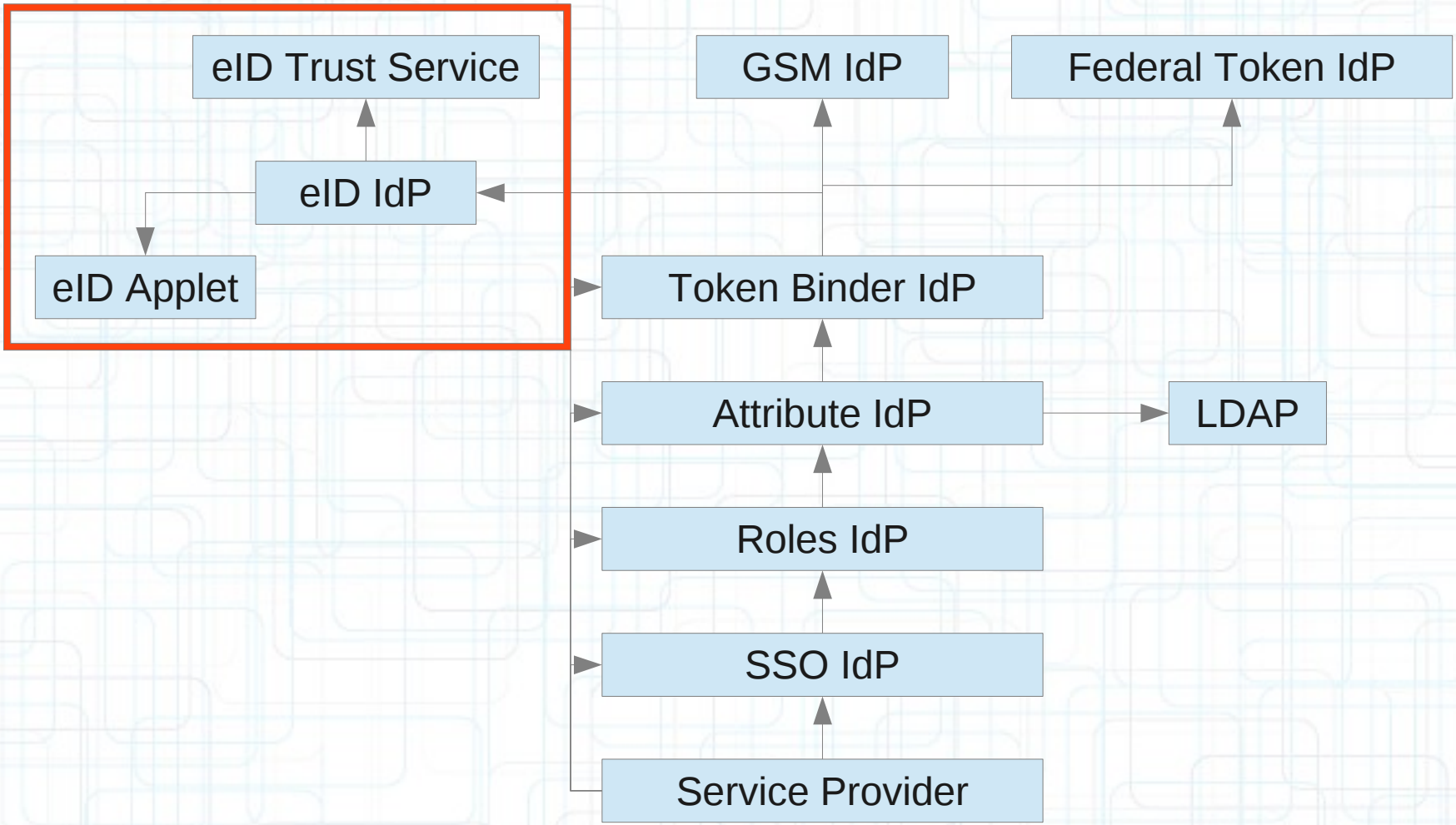
eID Identity Provider



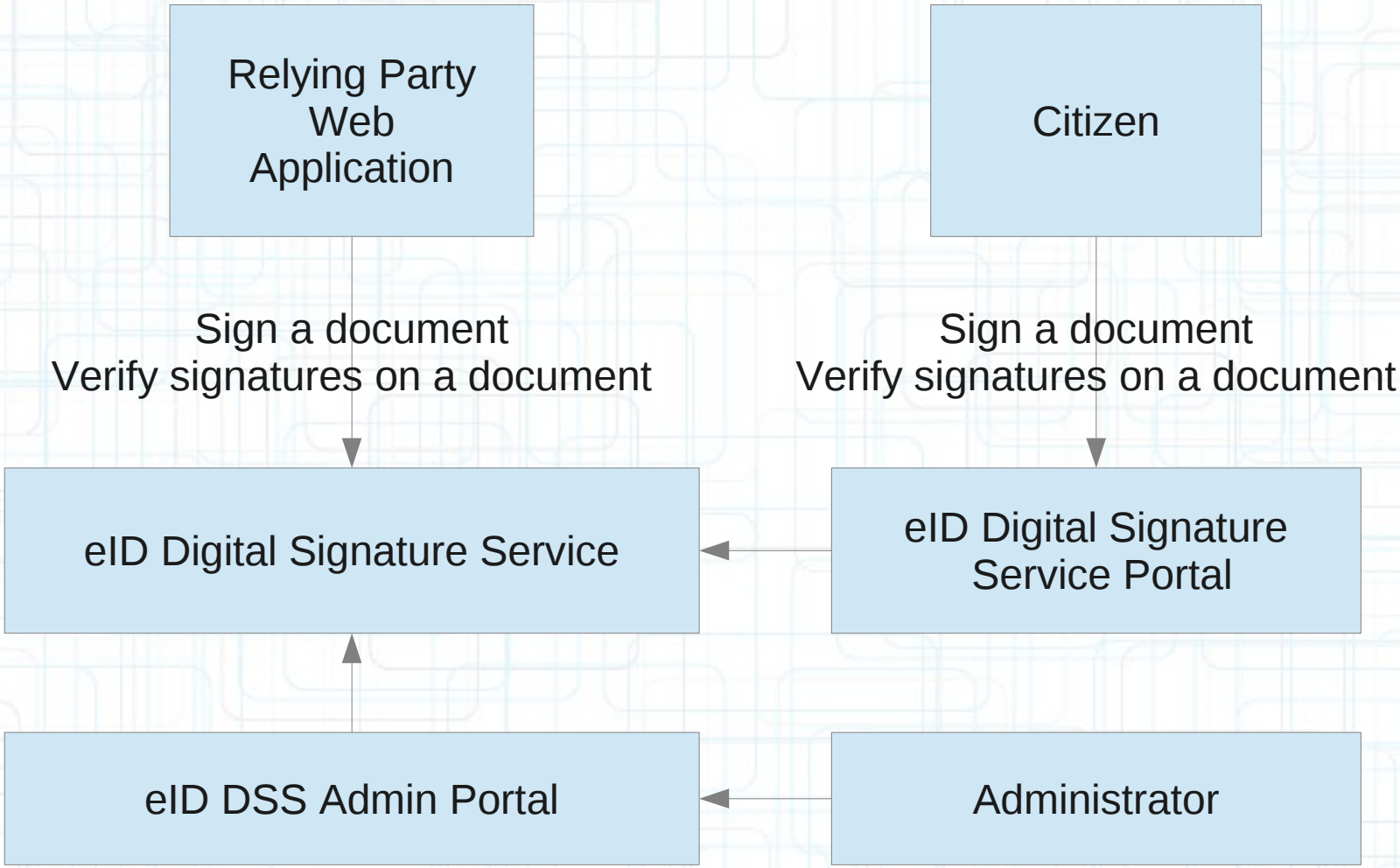
WebScarab Plugins



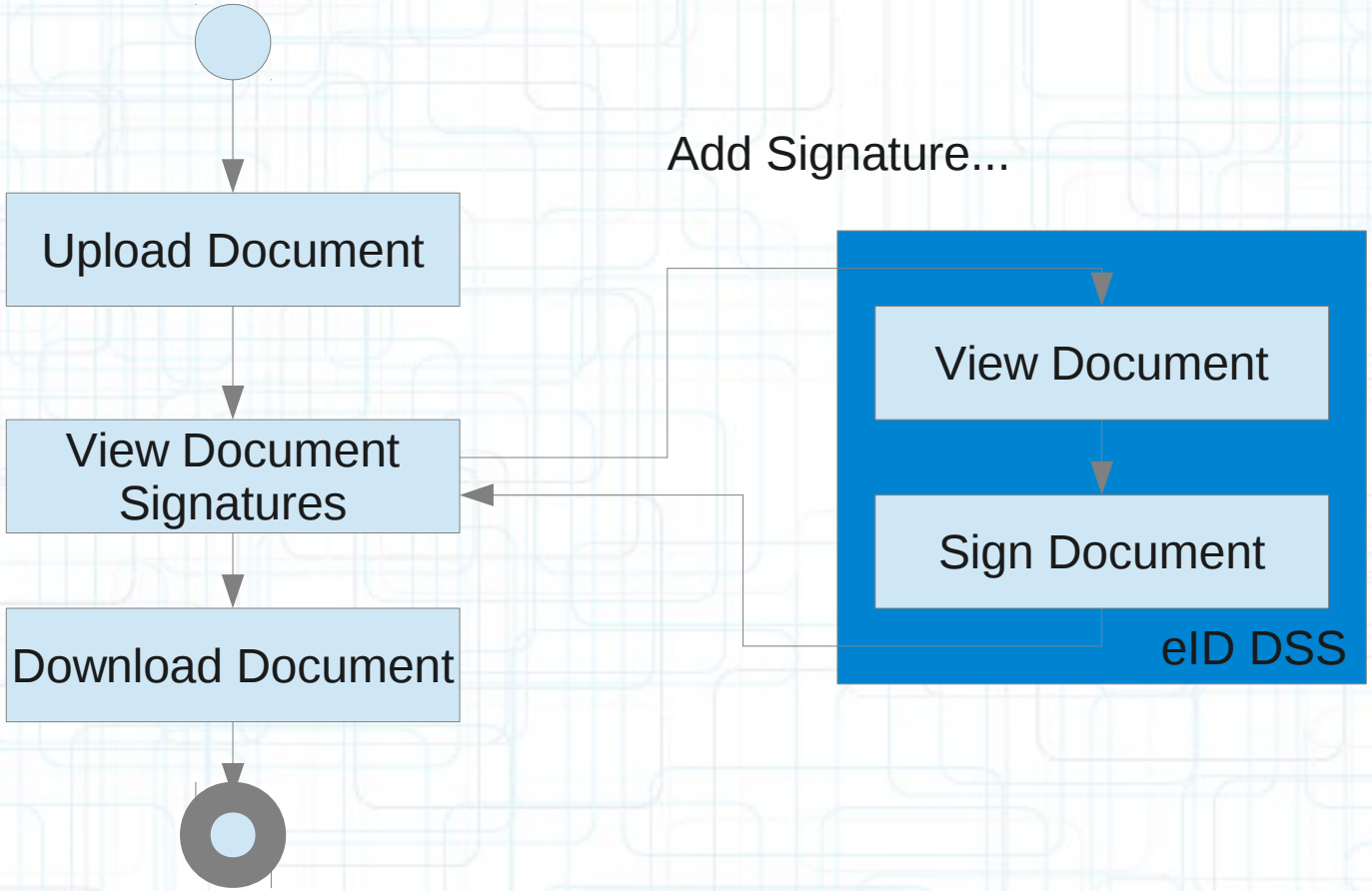
Identity and Access Management



eID DSS

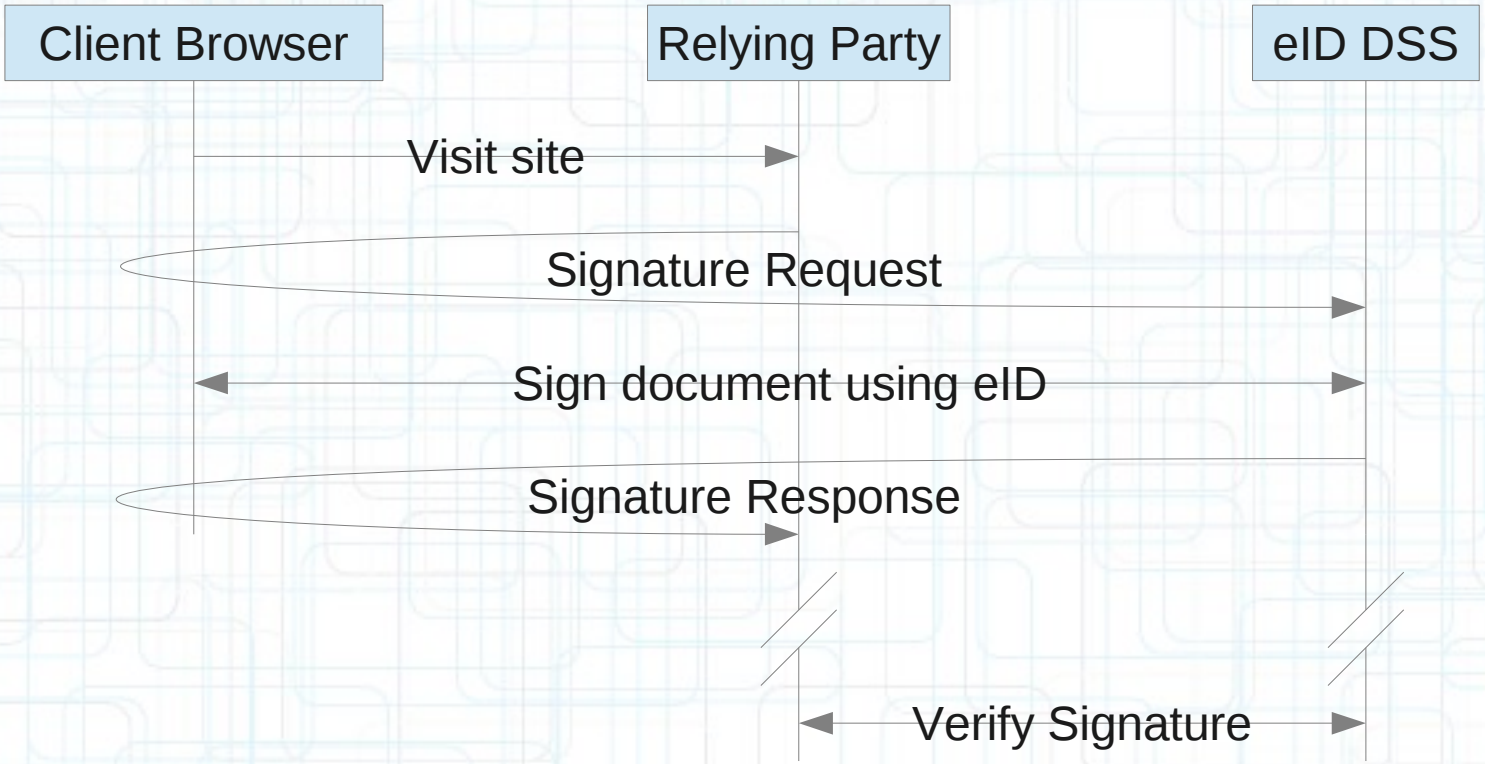

Relying Party Web Application
Citizen
Sign a document
Verify signatures on a document
Sign a document
Verify signatures on a document
eID Digital Signature Service
eID Digital Signature Service Portal
eID DSS Admin Portal
Administrator

eID DSS Work flow



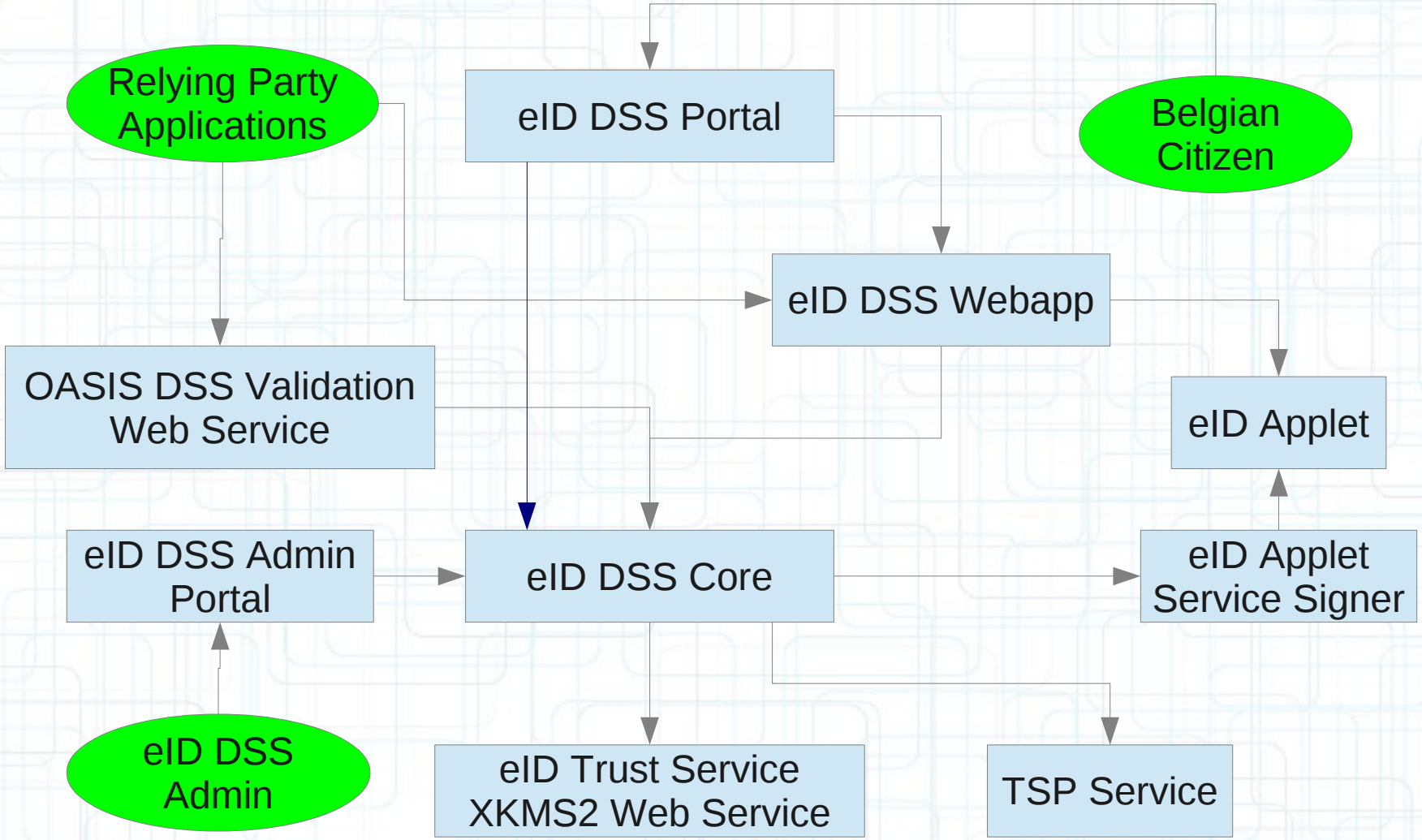
- Intuitive handling of multiple co-signatures

eID DSS Protocol Flow

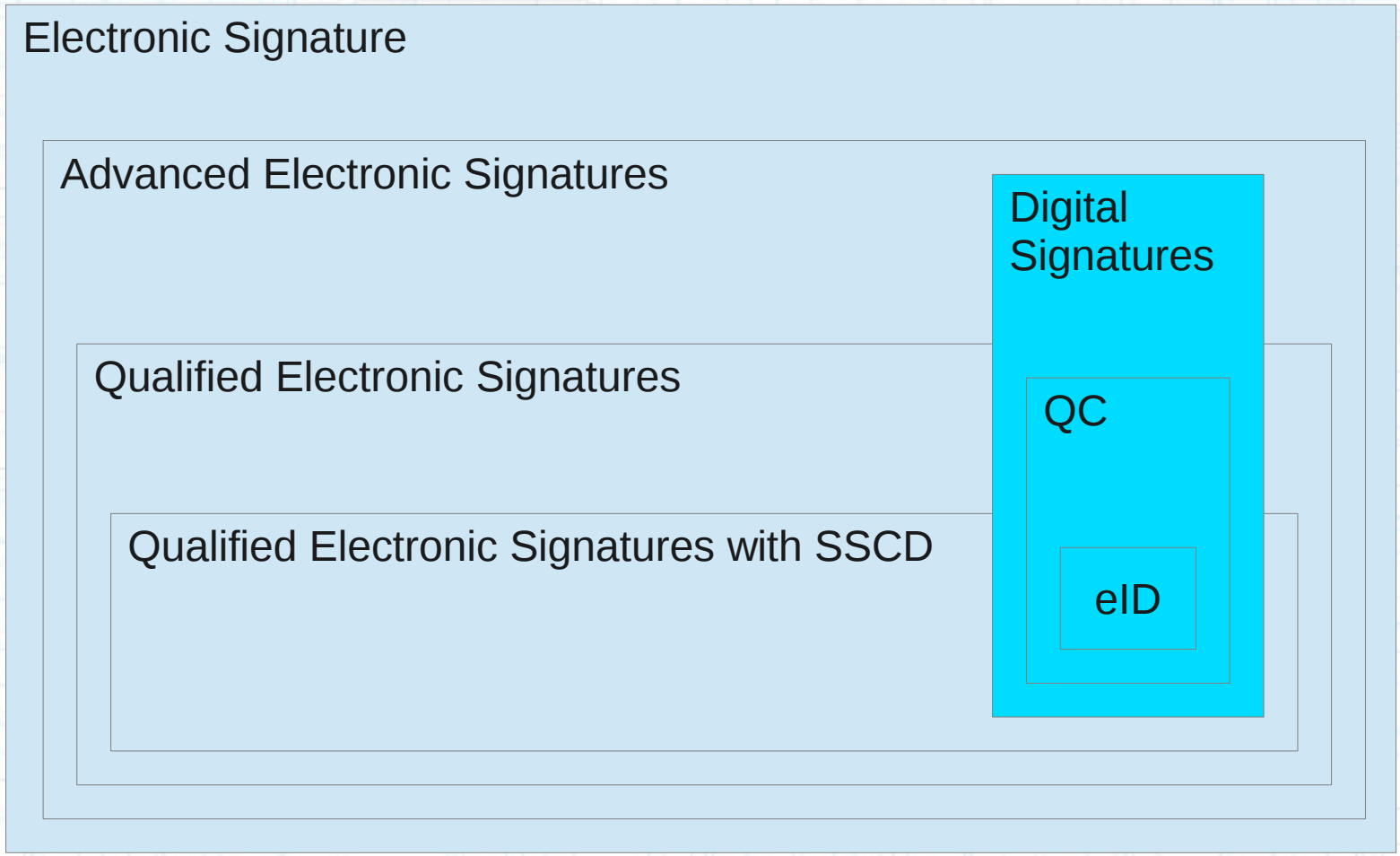


- Verification: OASIS DSS SOAP Web Service
- Creation: proprietary protocol for the moment
- Work in progress on OASIS DSS-X Local Signature Computation DSS Profile

eID DSS Architecture



Signature Types: EU Directive 1999/93/EC



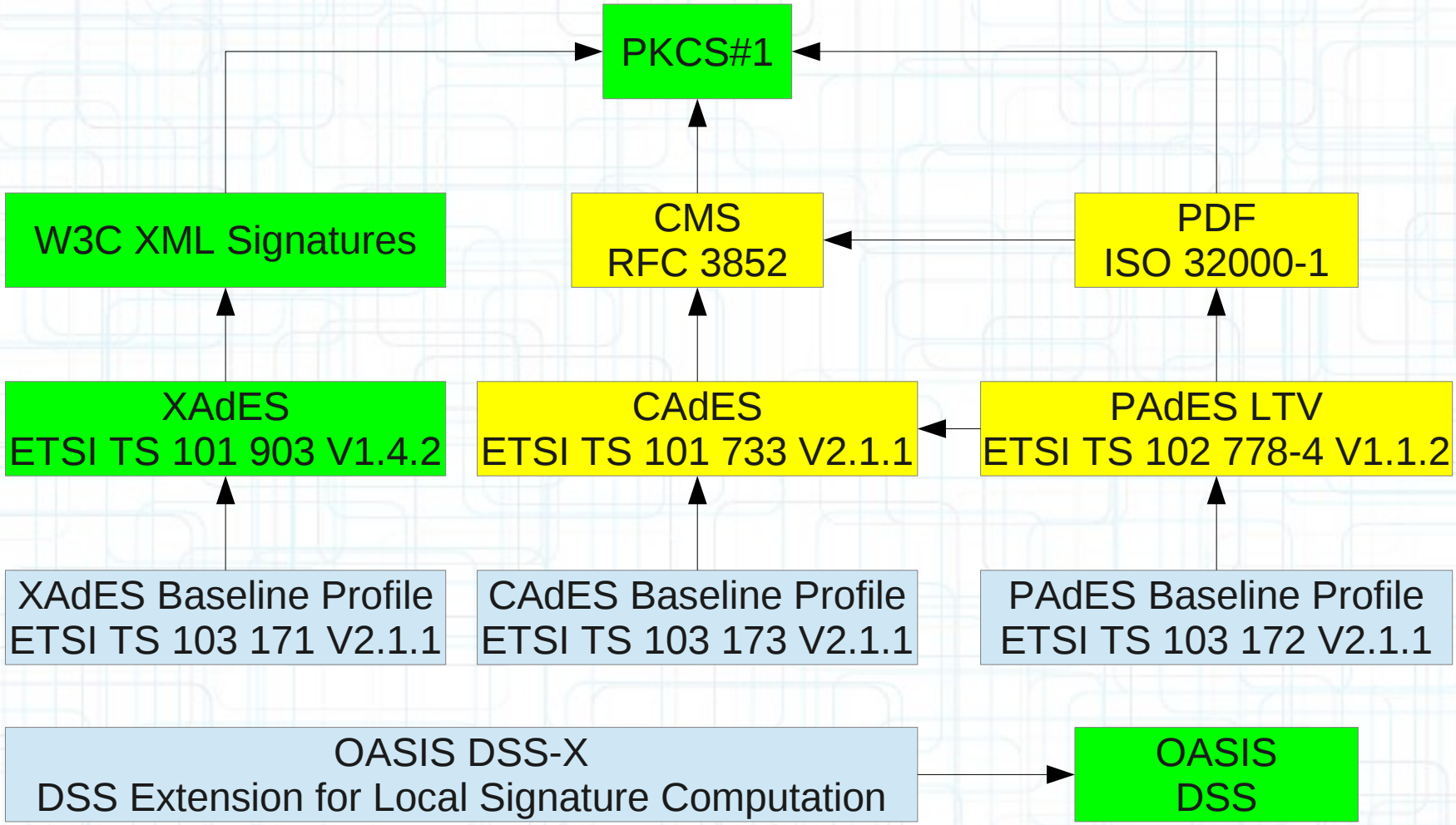
- Did Alice sign document D at time t ???

eID Signatures

	Authentication	Non-repudiation
Signature Verifier	Signature verifier = signature requestor	Signature verifier most likely not the signature requestor/creator.
Verification Time	Instantly	Most likely long after signature creation, certificate might already be revoked/expired.
Legal aspects	None required	Court might assign an expert to analyze the signature.

- Advanced Electronic Signatures thus require an open and self-contained signature format.
- Availability of independent implementations.

Signature Formats



eID DSS Document Formats

- ODF documents
  - Native ODF signatures: XAdES-X-L v1.4.2
  - Valid signatures in OpenOffice 3.2
- OOXML documents
  - Native OOXML signatures: XAdES-X-L v1.4.2
  - Valid signatures in MS Office 2007/2010
- XML documents
  - Co-signatures: XAdES-X-L v1.4.2
- ZIP container

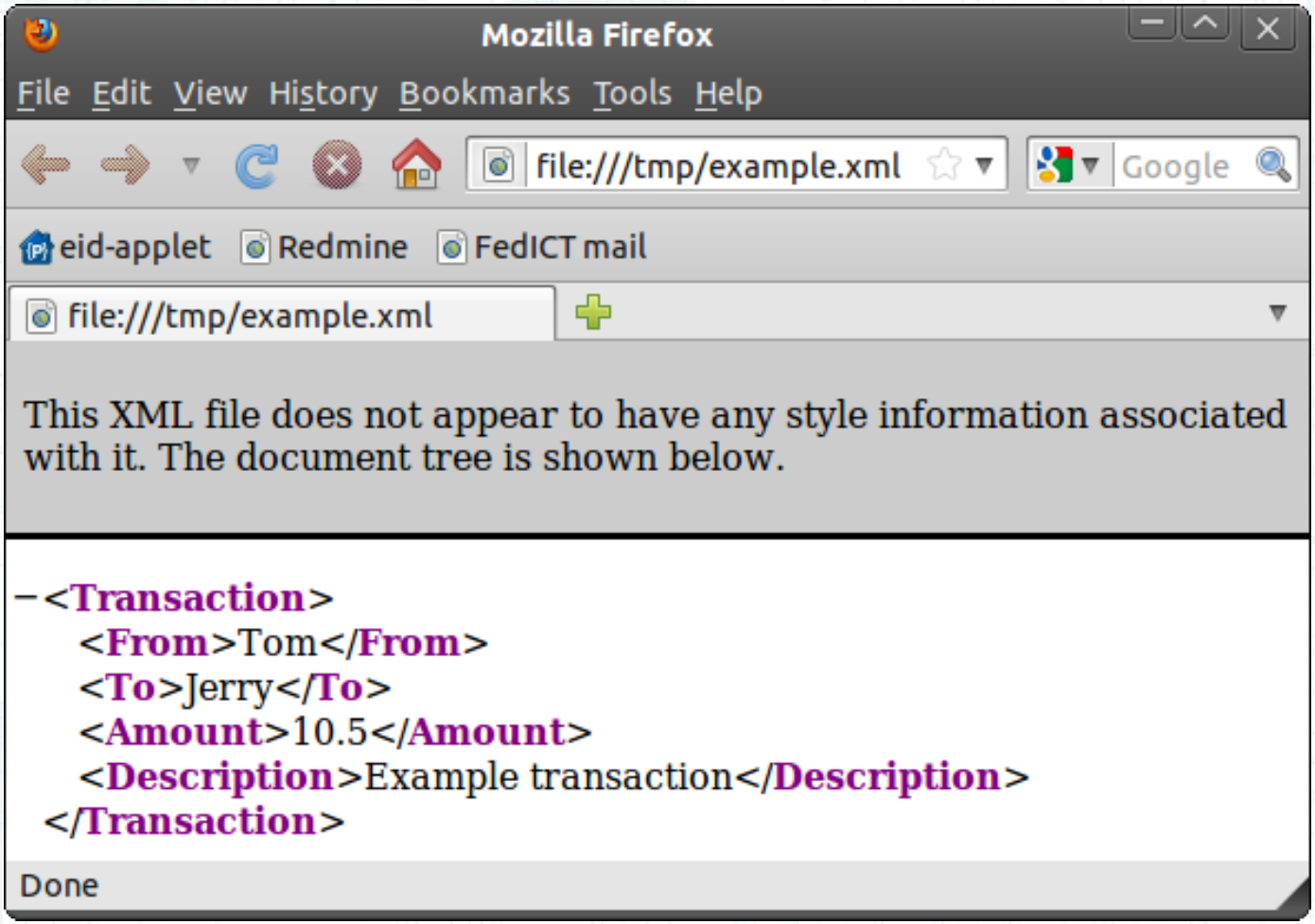
Signature Format versus Document Format

	XAdES	CAdES	PAdES
XML	Native	Container	Container
ODF	Native	Container	Container
OOXML	Native	Container	Container
Binary	Container	Native	Container
PDF	Container	Container	Native

- Native: document format has native support for the signature format.
- Container: the document format has no support for the signature format. Thus we need to construct a document container suited for the given signature format.
- Only XAdES is versatile towards doc formats.

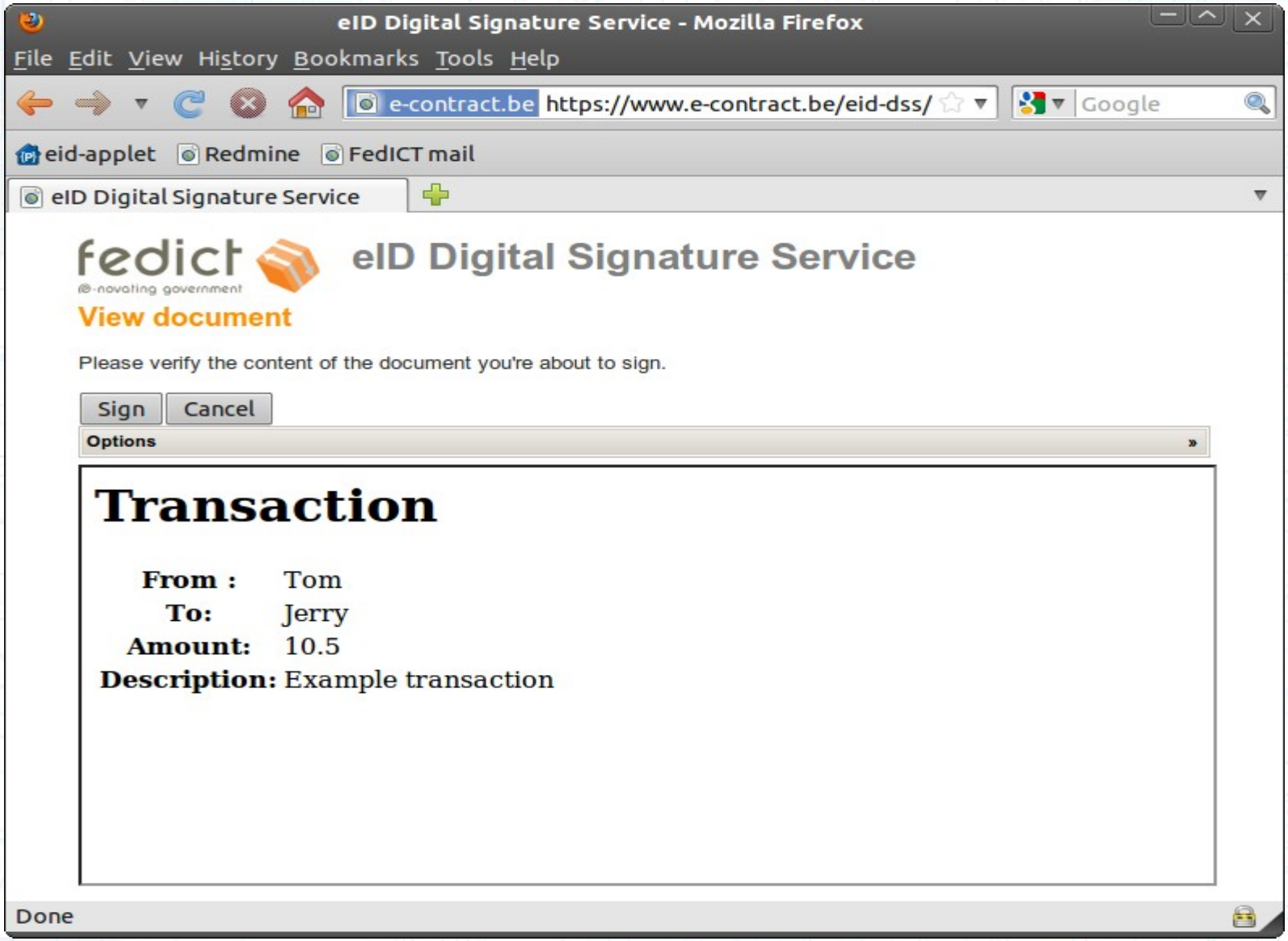
eID DSS: XML document format

- Business Domain Specific Language in XML
- Example: a financial transaction



eID DSS: XML document format

- The application uses eID DSS to sign the XML



Q&A

- https://www.e-contract.be
- https://code.google.com/p/eid-applet/
- https://code.google.com/p/eid-idp/
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- https://code.google.com/p/eid-trust-service/
- https://code.google.com/p/commons-eid/
- https://code.google.com/p/eid-mw/