



# The Belgian e-ID: hacker vs developer

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# Agenda

- eID Card Introduction
- eID Card Integration
- Examples of bad implementations



# Who are we?

- Frank: eID Architect at Fedict
  - eID Middleware
  - eID Applet
  - eID Trust Service, jTrust, eID IdP, eID DSS
- Erwin: whitehat hacker at ZION SECURITY



# eID Card Introduction





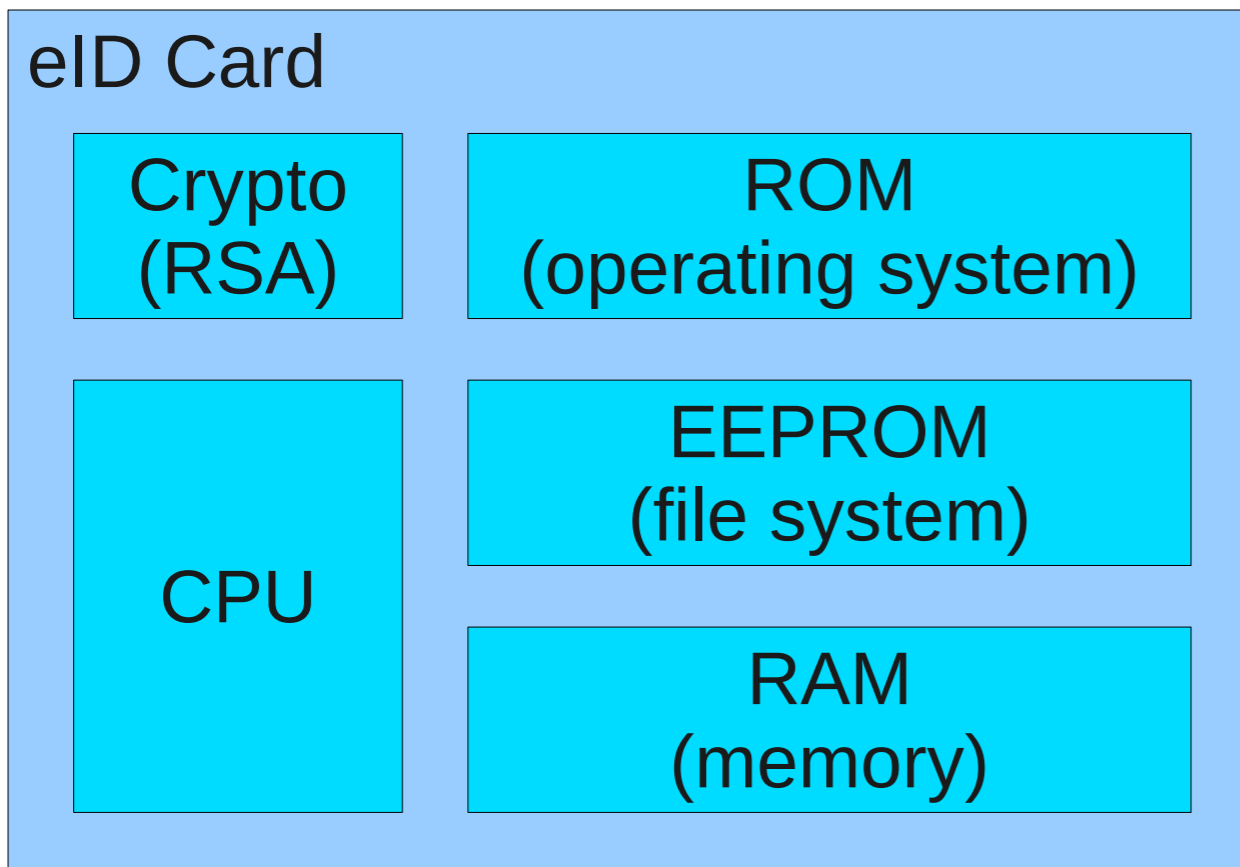
# eID in Belgium

- eID cards issued (16/01/2010)
  - 8.220.456 citizen eID cards (full deployment)
  - 511.774 foreigner eID cards
  - 186.011 kids eID cards
- Technology
  - RSA 1024 smart card
  - QC with 5 year validity
- Involved major organizations:
  - FedICT: Federal ICT
    - PKI, client software, SOA solutions
  - National Registry
    - user database, card issuing

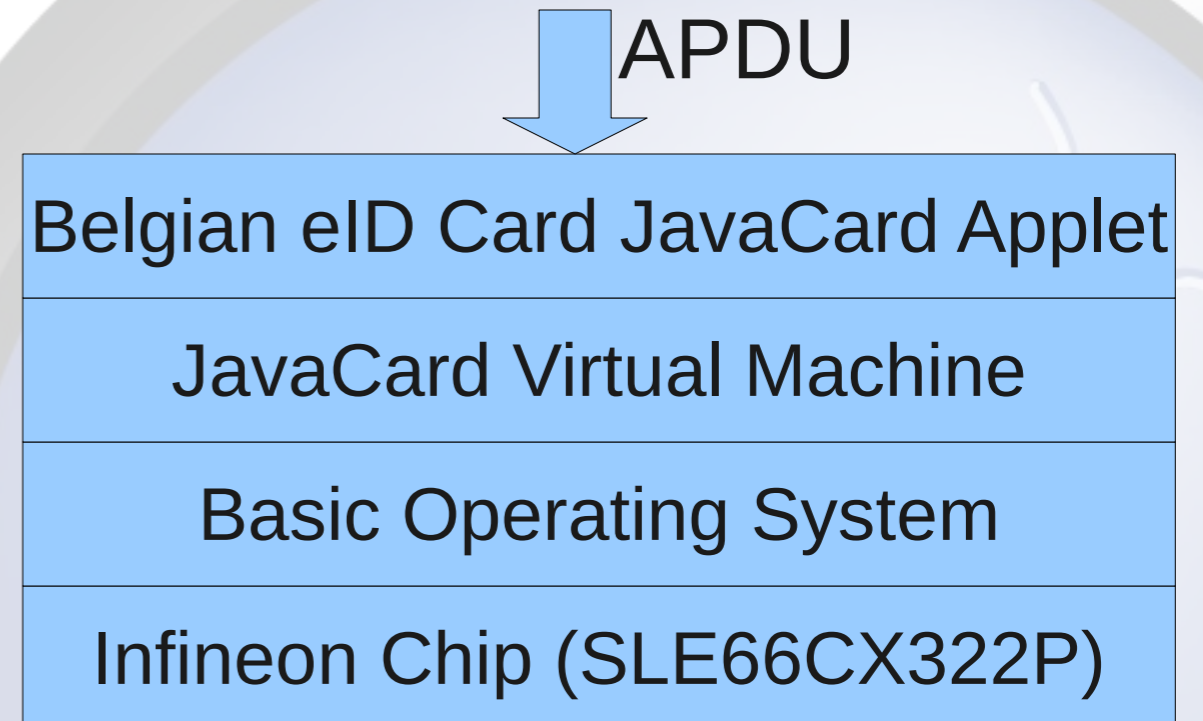


# eID Card

## Physical Structure

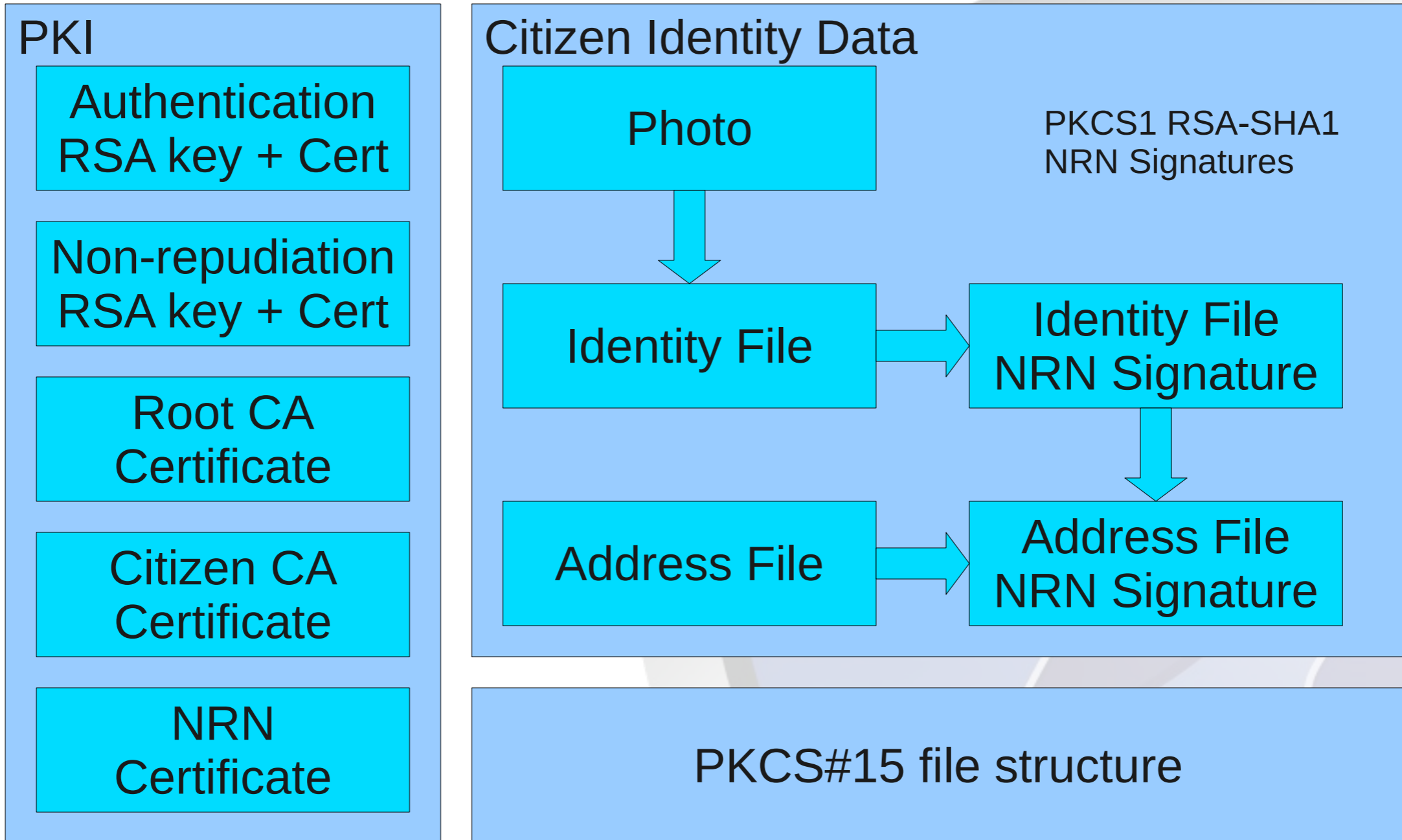


## Logical Structure





# eID Card Content





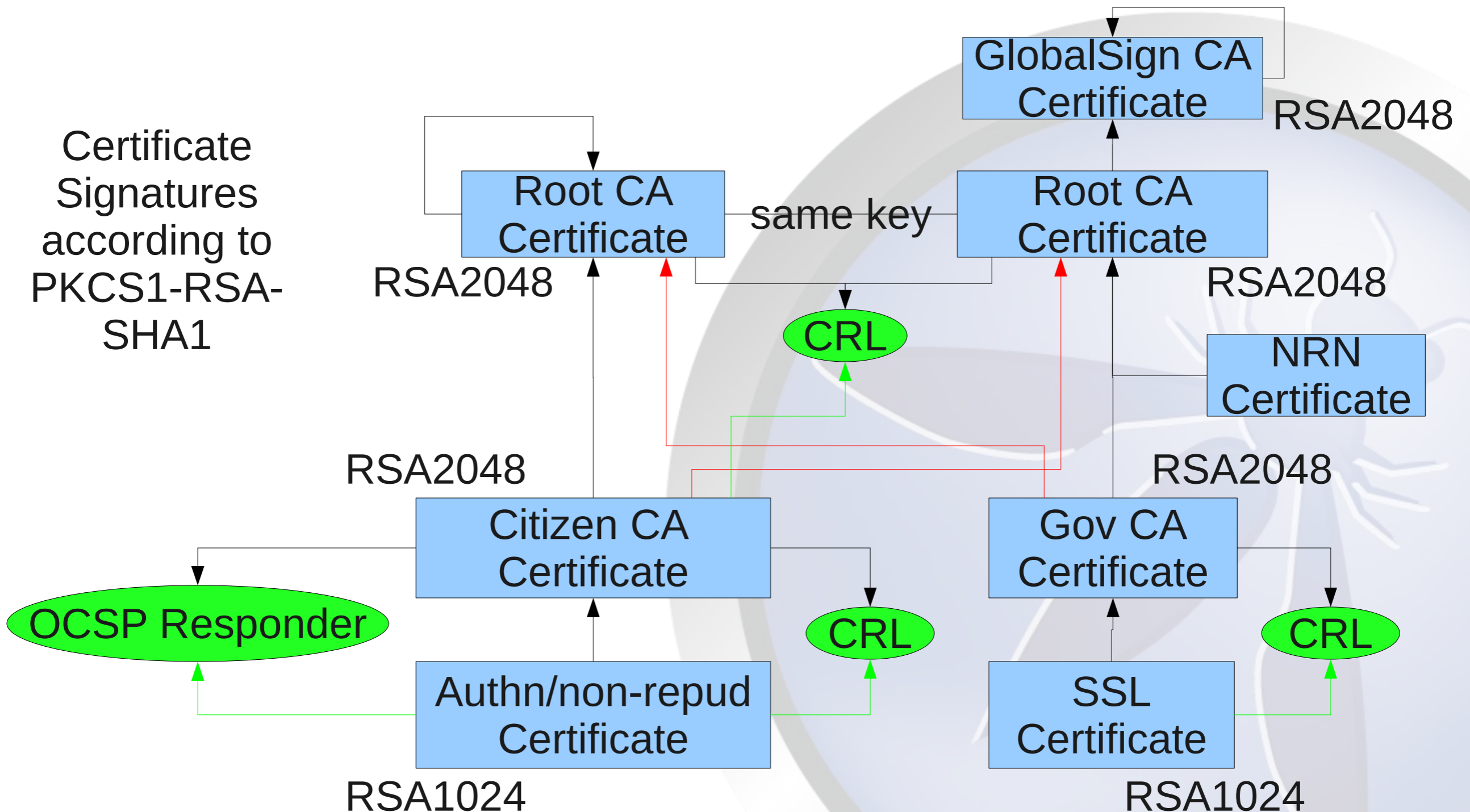
# eID Card Functionality

- Non-electronic functionality
  - Visible Identification
  - Visible Authentication via facial recognition and/or hand-written signature (a kind of challenge)
- Electronic functionality
  - Identification: who are you?
    - Passive eID usage
    - Privacy sensitive
  - Authentication: can you prove who you are?
    - Active challenging the eID card + eID user (2 factor)
  - Digital Signing: non-repudiation signature
    - Prove of acknowledgment at a point in time





# eID PKI Topology





# eID Card Integration





# eID Card Interfacing

- Via APDU messages
  - Application Protocol Data Unit
  - Command: from the reader to the card
  - Response: from the card to the reader
- Example: Creation of a signature
  - Set APDU: select the key. 0x82 = authn key
  - Prepare DigestInfo PKCS1 DER sequence
  - Verify PIN APDU: (PIN BCD encoded)
  - Compute Digital Signature APDU
  - Retrieve signature data
- Doing the APDU interface is crazy

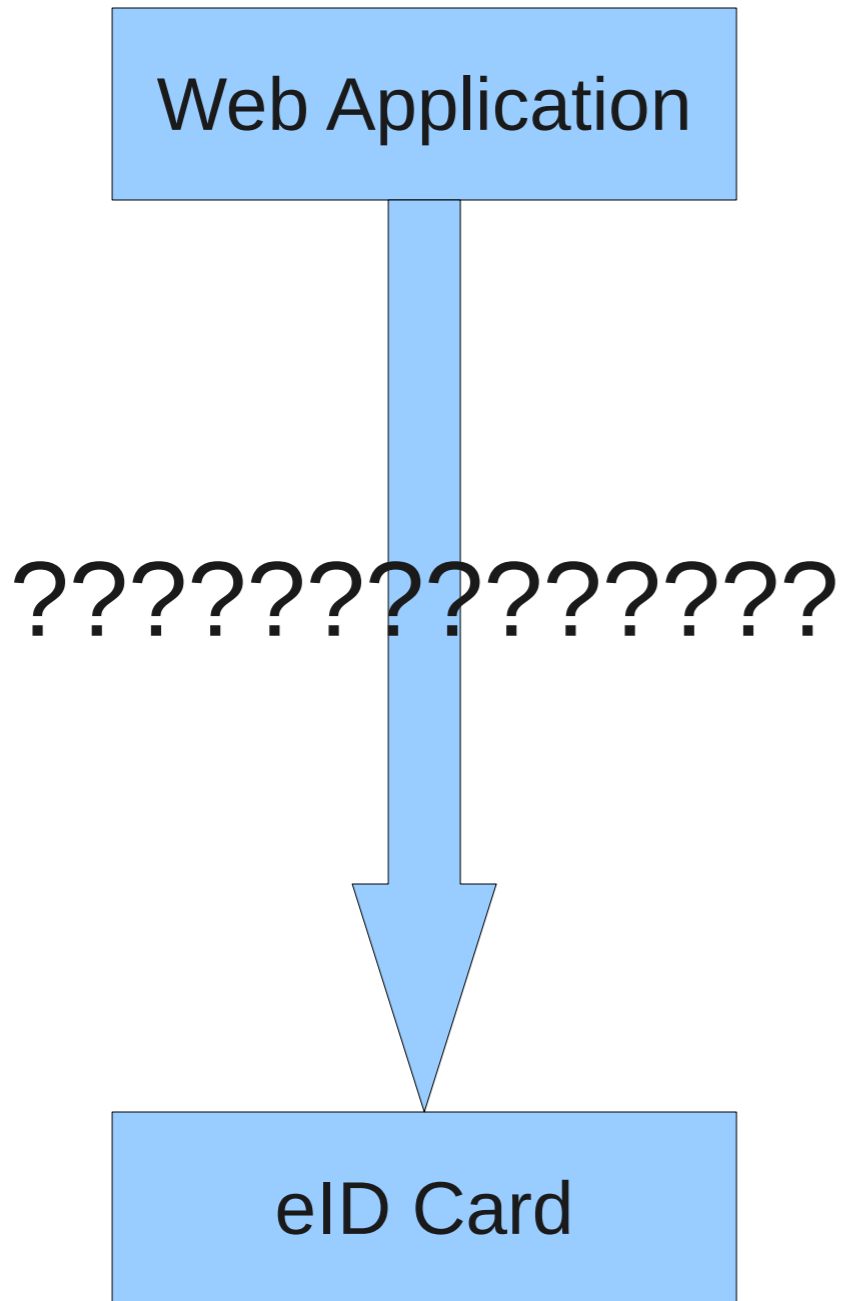


# eID Card APDU Demo





# eID Card Integration

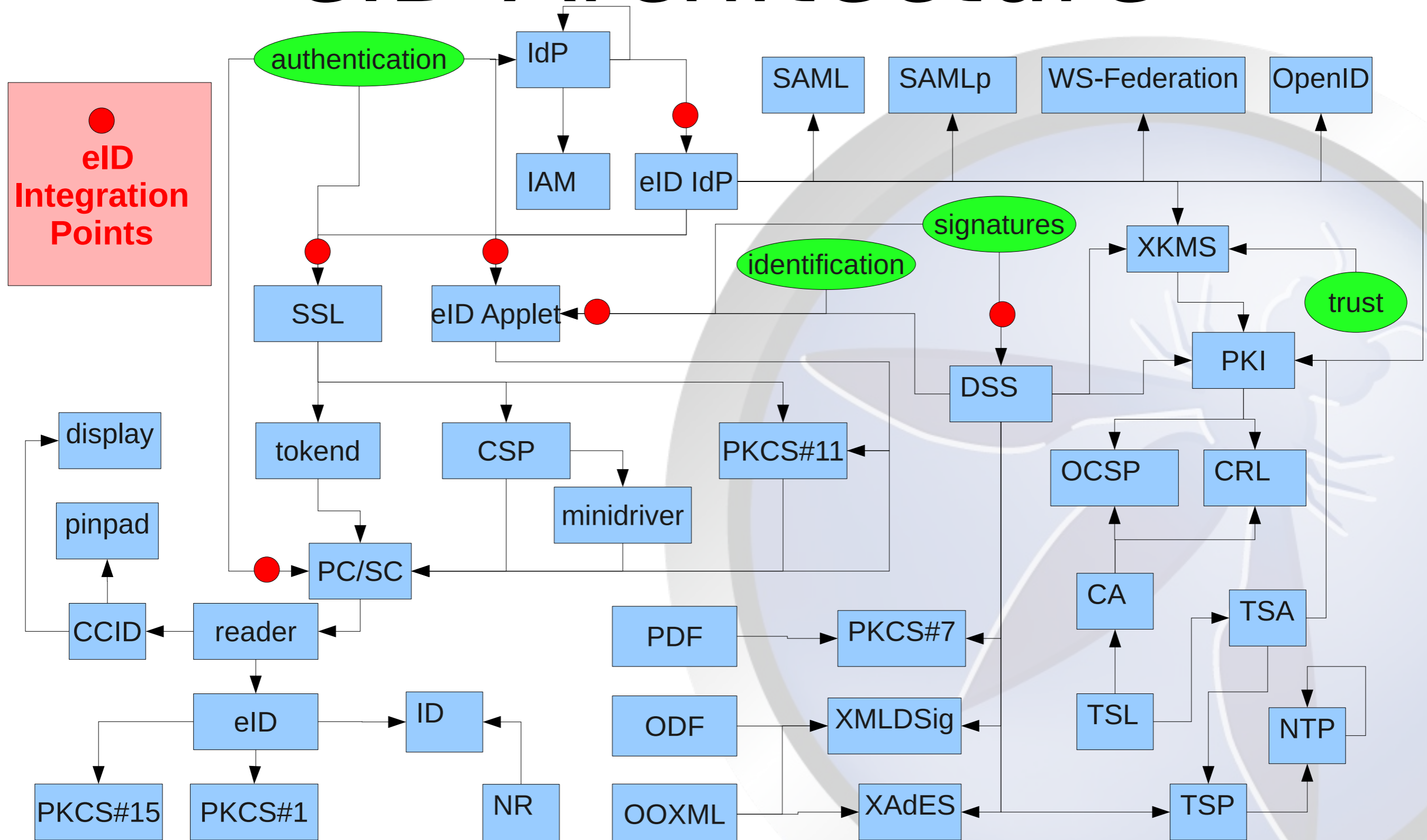


## *Important aspects when integrating:*

- Ease of integration
- Secure usage of eID
- Platform independent solution:
  - Windows
  - Linux
  - Mac OS X
- Multiple browser support:
  - Firefox
  - MS IE
  - Safari
  - Chrome
- Integration point abstraction level
- Idiot proof eID components

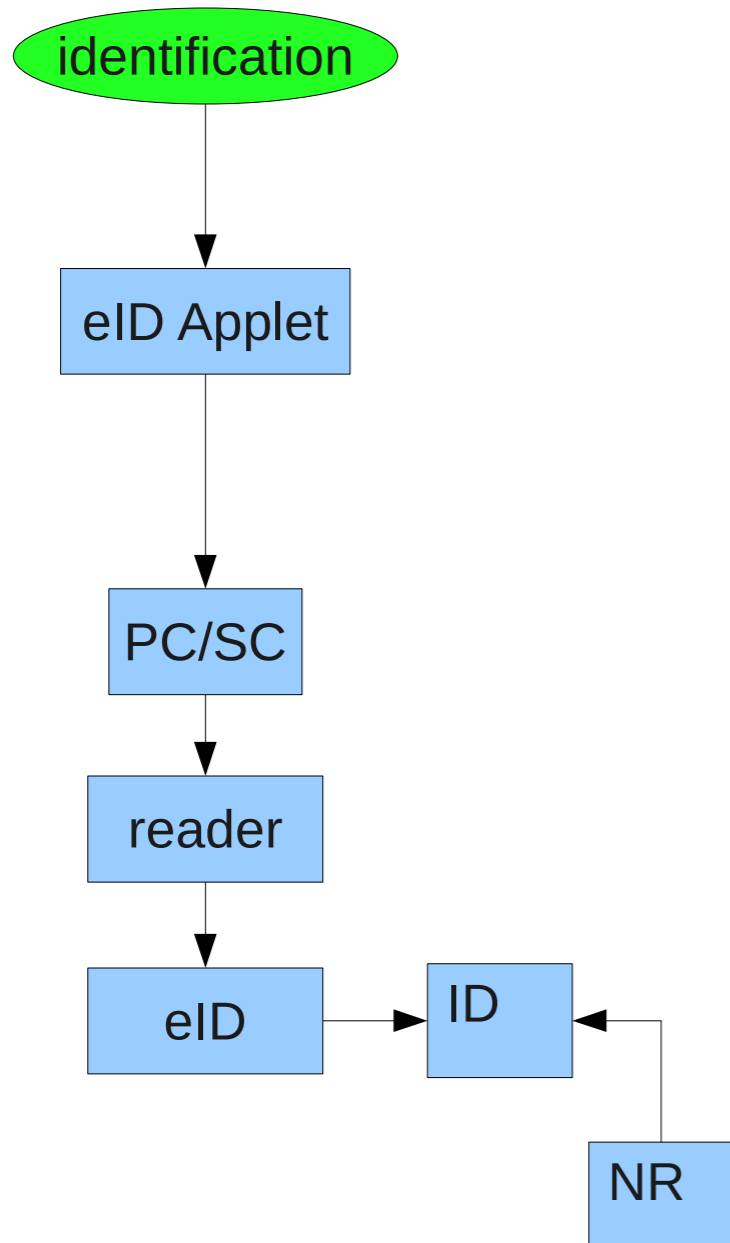


# eID Architecture





# eID Identification



- Identification: who are you?
- Readout of the eID Identity, Address and Photo files.
- Server-side identity file parsing
- Server-side integrity validation of all identity files is possible via NRN signature



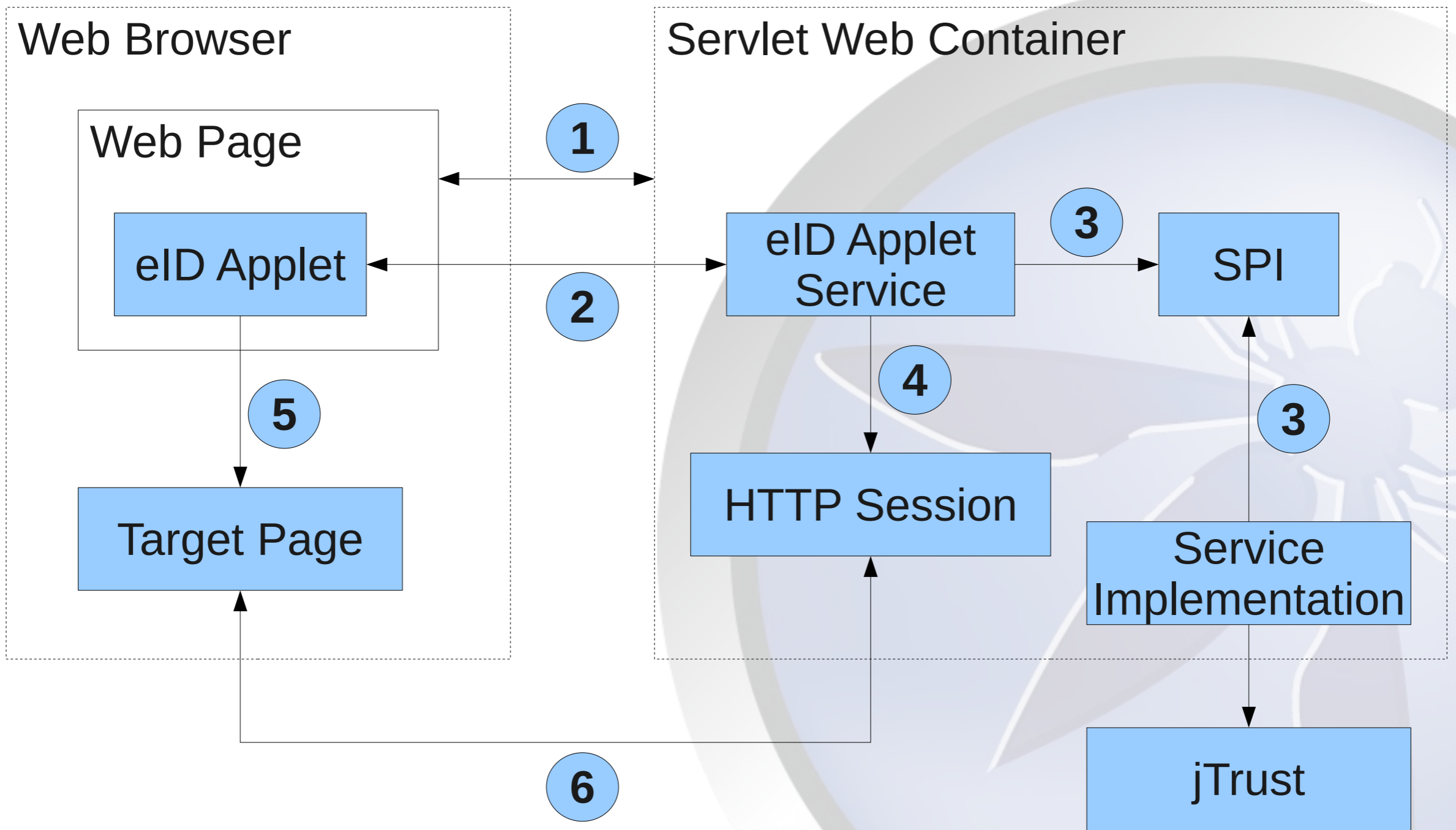
# eID Applet

- Java 6 Web Browser eID Component
- Supports multiple web browsers:
  - Firefox, Chrome, Internet Explorer, Safari
- Platform-independent:
  - Windows, Linux, Mac OS X
- Interactive eID card handling
- Support for secure CCID pinpad readers
- Web developer friendly
- Open Source Software: GNU LGPL 3
  - <http://code.google.com/p/eid-applet/>





# eID Applet Architecture



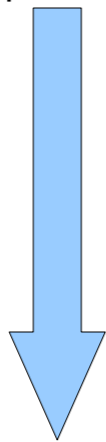
SPI design pattern is key to enabling eID Applet features



# eID Applet Identification

## 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.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>
```



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>
```

## identification-result-page.jsp

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





# eID Identification Demo





# eID Identity Integrity

- eID Applet reads the identity files and NRN signatures, posts to eID Applet Service
- Server-side verification of the NRN signatures over the identity, photo and address files by the eID Applet Service
- Verification of the NRN certificate chain via the IdentityIntegrityService SPI

```
<servlet>
  <servlet-name>AppletIntegrityServiceServlet</servlet-name>
  <servlet-class>be.fedict.eid.applet.service.AppletServiceServlet</servlet-class>
  <init-param>
    <param-name>IdentityIntegrityService</param-name>
    <param-value>/location/in/jndi/of/the/IdentityIntegrityServiceBean</param-value>
  </init-param>
</servlet>
<servlet-mapping>
  <servlet-name>AppletIntegrityServiceServlet</servlet-name>
  <url-pattern>/applet-service-integrity</url-pattern>
</servlet-mapping>
```



# eID Identification Demo

## Integrity Validation



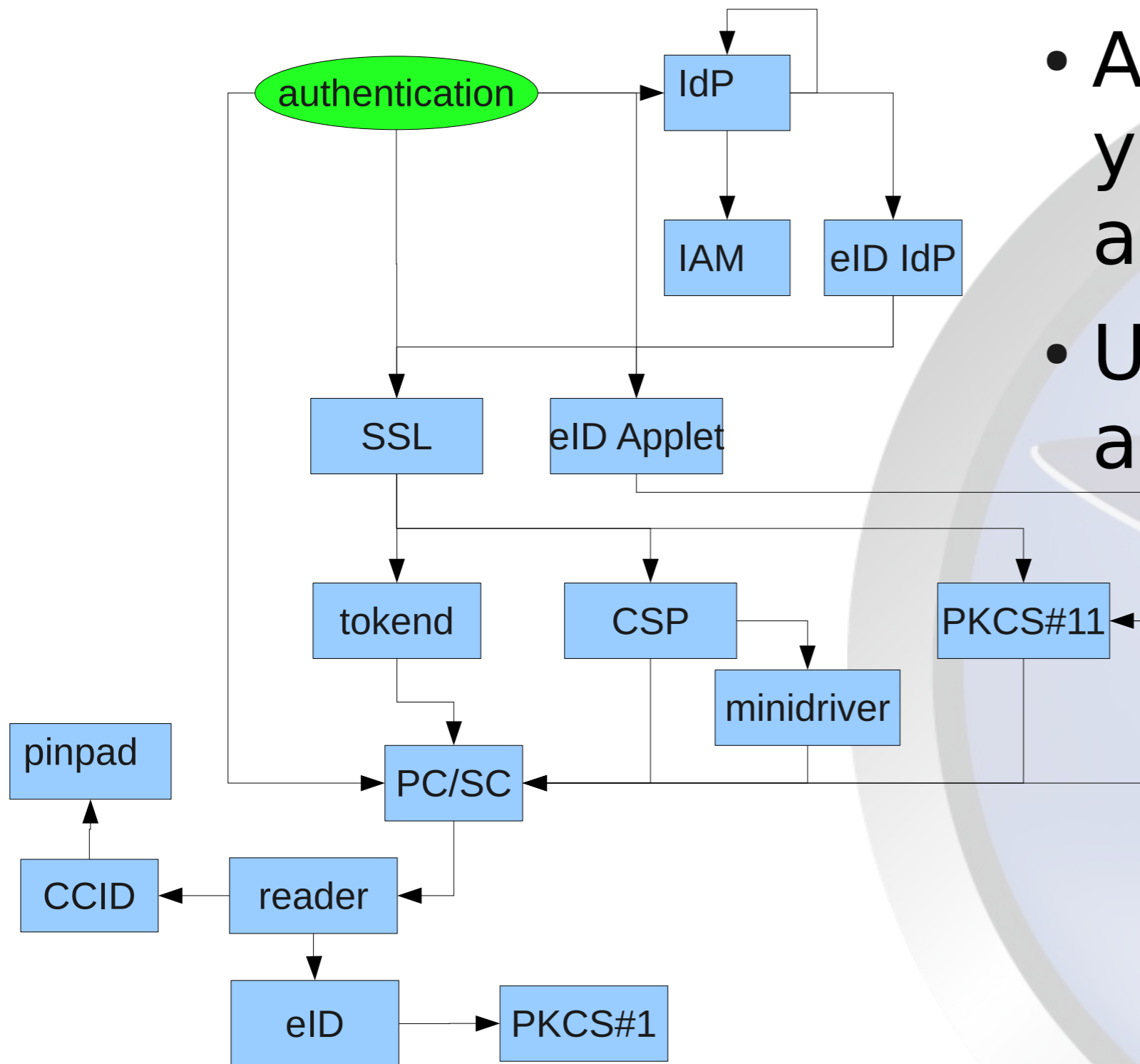
# eID Card Cloning

- eID has a 3th key pair: card authn key
- eID Card Authentication signature can be created without PIN verification
- eID Card Authentication allows for detection of a cloned eID card
- eID Card Authentication signature cannot be verified due to missing corresponding public key.
- National Registry needs to make the public key available as an eID file
- Would prevent identity fraude



# eID Authentication

- Authentication: can you prove who you are?
- Using the eID authentication key





# Entity Authentication

- Entity authentication is the process whereby one party is assured of the identity of a second party involved in a protocol, and that the second has actually participated (i.e., is active at, or immediately prior to, the time the evidence is acquired)
- Formal definition (A authenticated B if):
  - Alice A, Bob B
  - A believes freshness challenge\_A
  - A believes (B recently said challenge\_A)
- Authentication vs. Session Key Establishment
- How to achieve this using an eID card?





# eID Authentication

- Authentication Private Key (1024 bit RSA)
  - PKCS1-RSA
  - PIN authorization for Authn Key usage
  - Card caches the authn PIN authorizations
  - Log-off instruction to reset PIN authorization
- Creation of a signature:
  - Set APDU: select the key. 0x82 = authn key
  - Prepare DigestInfo PKCS1 DER sequence
  - Verify PIN APDU: (PIN BCD encoded)
  - Compute Digital Signature APDU
  - Retrieve signature data
- eID can only sign (RSA decryption of DigestInfo)



# Authentication Protocol

- eID authentication by itself is useless
- Remote Entities, e.g. web application context.
- We need an Authentication Protocol
- Different Authentication Protocols are possible
- Each Entity Authentication Protocol yields its own cryptographic goals.
  - Of course Entity Authentication
  - Session key via combined Key Agreement (SSL)
- DO NOT TRY TO INVENT YOUR OWN PROTOCOL!
  - Needham-Schroeder protocol: replay attack
  - Creativity is great for non-critical applications, like music.

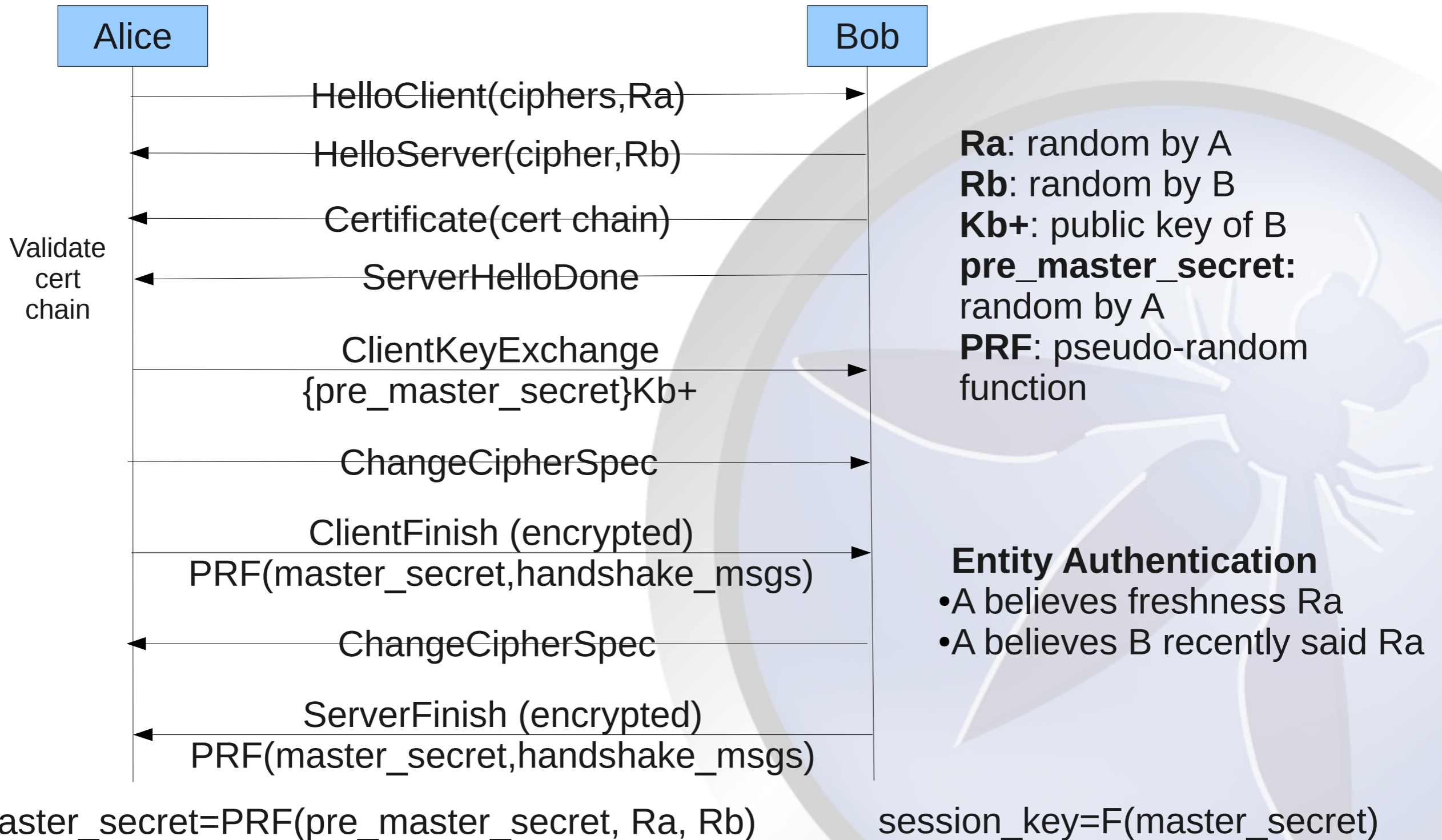


# Candidate Protocols

- Mutual SSL
  - Browser initiated SSL handshake
  - Relies on eID PIN authorization caching feature
- Tunnelled Entity Authentication
  - Uses unilateral SSL to authenticate the server
  - Based on ISO/IEC 9798-3 Authentication SASL Mechanism (RFC 3163)
  - Cryptographic channel binding to secure the channel (RFC 5056)
  - Requires an eID Applet (or browser extension)
  - Explicit eID card management possible
  - Sequential eID card access possible



# Unilateral SSL



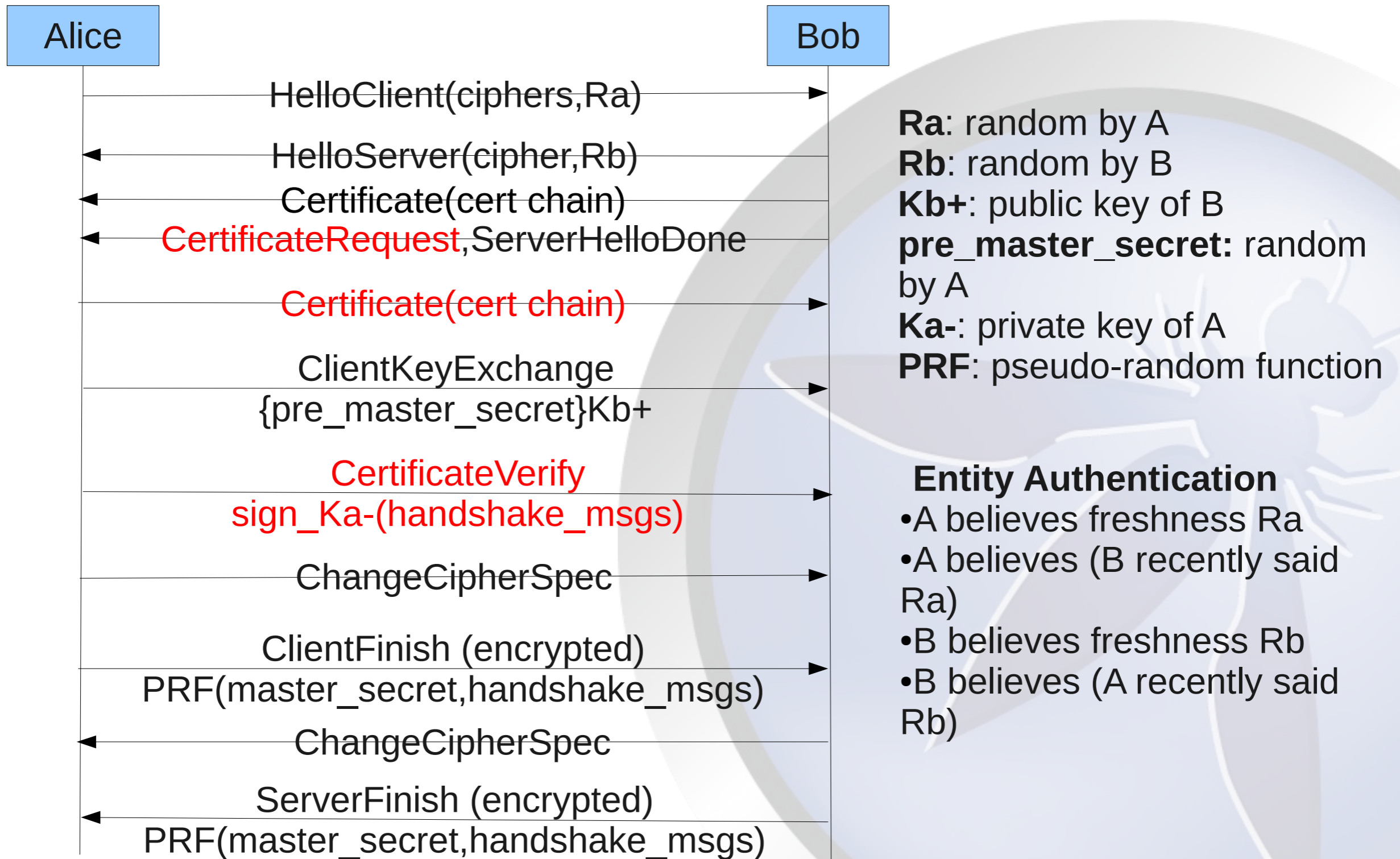


# SSL Features

- Resuming a TLS connection
  - HelloClient(session\_id)
  - Reusing the same master\_secret
  - Reduces load due to a full TLS handshake
- Renegotiating the SSL handshake
  - Over an already established SSL connection
  - Useful when client authentication is required
  - Both client and server can initiate a renegotiation
  - Not all SSL stacks support this (Java does not)
  - Security flaws in implementations



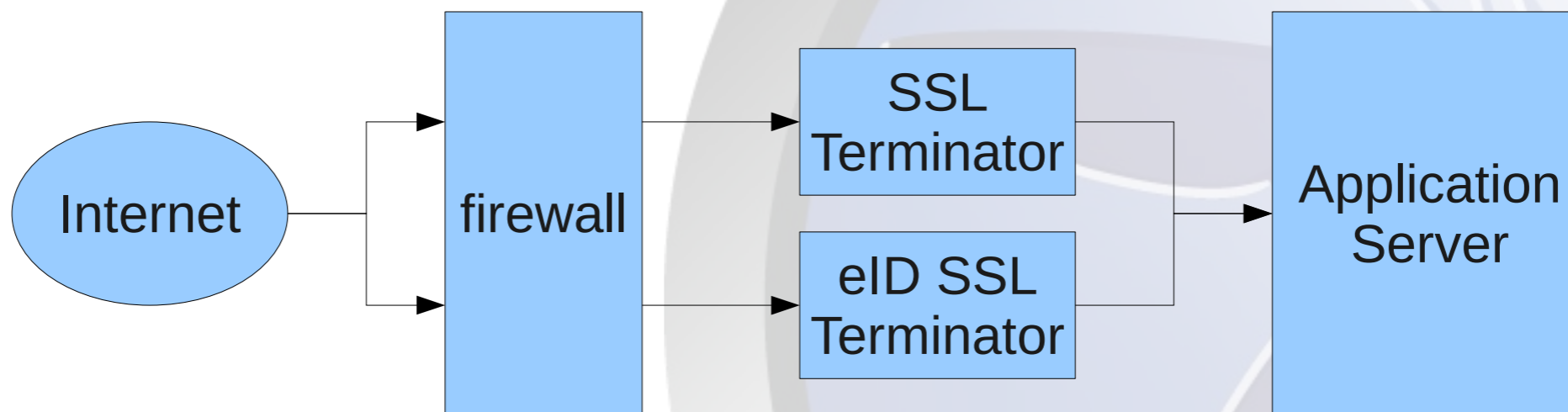
# Mutual SSL via eID





# eID SSL Authentication

- So we need two SSL terminations:
  - One for unilateral SSL
  - One for the mutual SSL using eID
- Requires 2 IP addresses (+ DNS names), or at least 2 different ports.

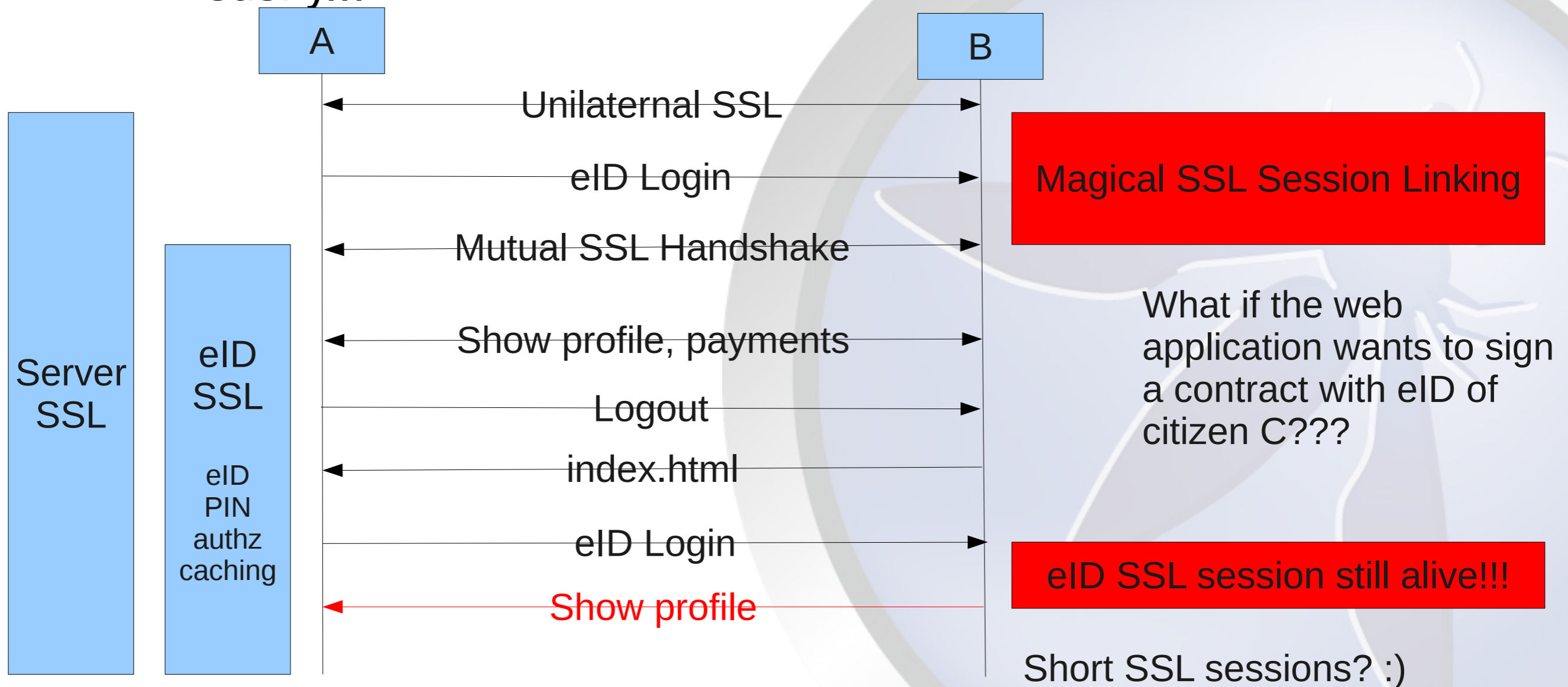


- Problem: how to properly link the SSL sessions?
  - If same IP address, via session cookies
  - If different IP address, via signed SAML tickets



# eID SSL Authentication

- How about session life cycles?
- The Application Server cannot inform SSL to terminate that easily...



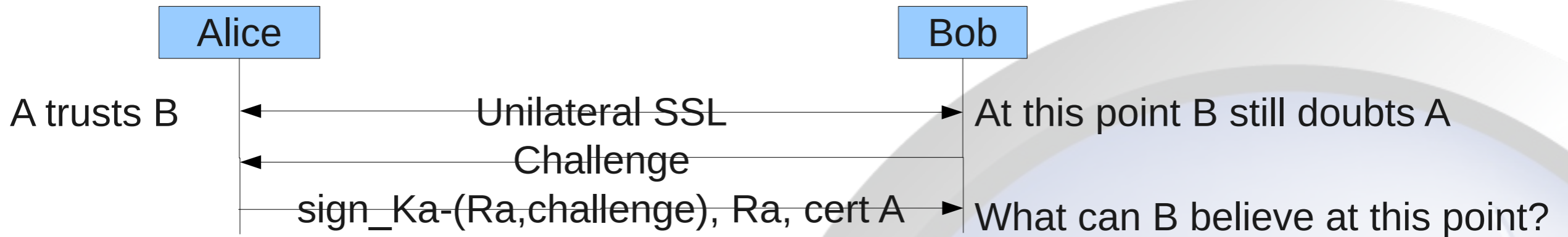




# eID SSL Authentication Demo



# Tunneled Entity Authn



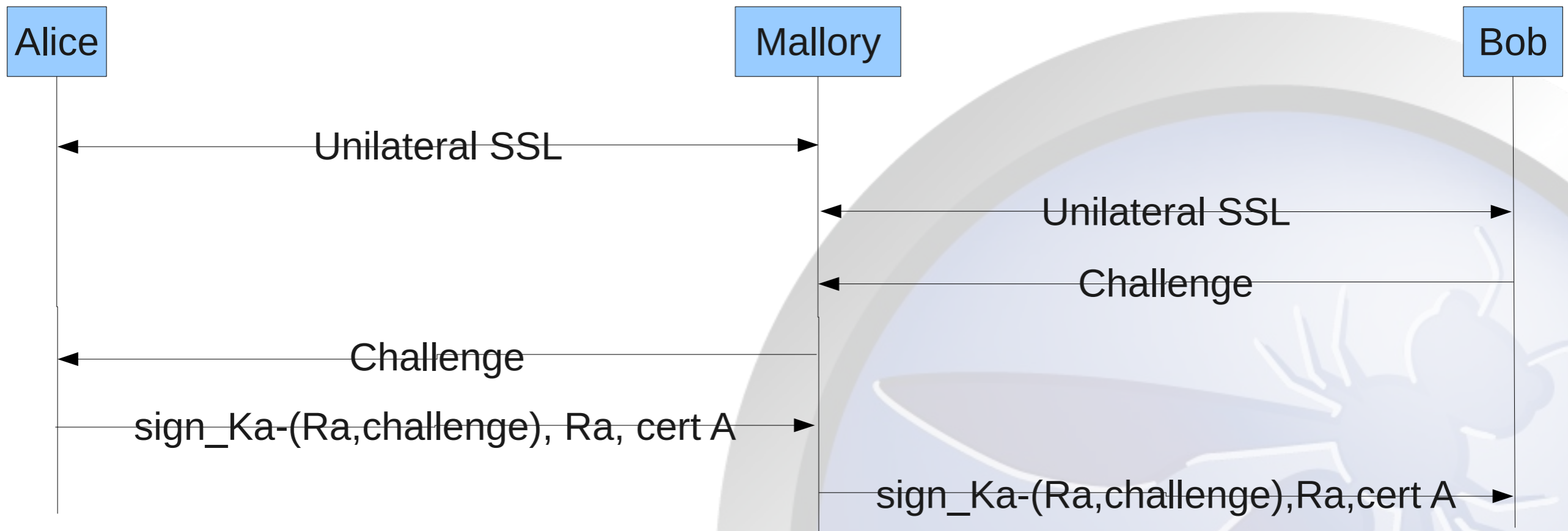
- ISO/IEC 9798-3 Authentication SASL Mechanism
  - RFC 3163
  - Unilateral client authentication: server already authenticated via unilateral SSL connection
- Did we achieve the same effect as mutual SSL?
- What if challenge actually is  $\text{SHA1}(\text{contract})$ ?
- B can abuse A's challenge signature.



# eID Tunneled Entity Authentication Demo



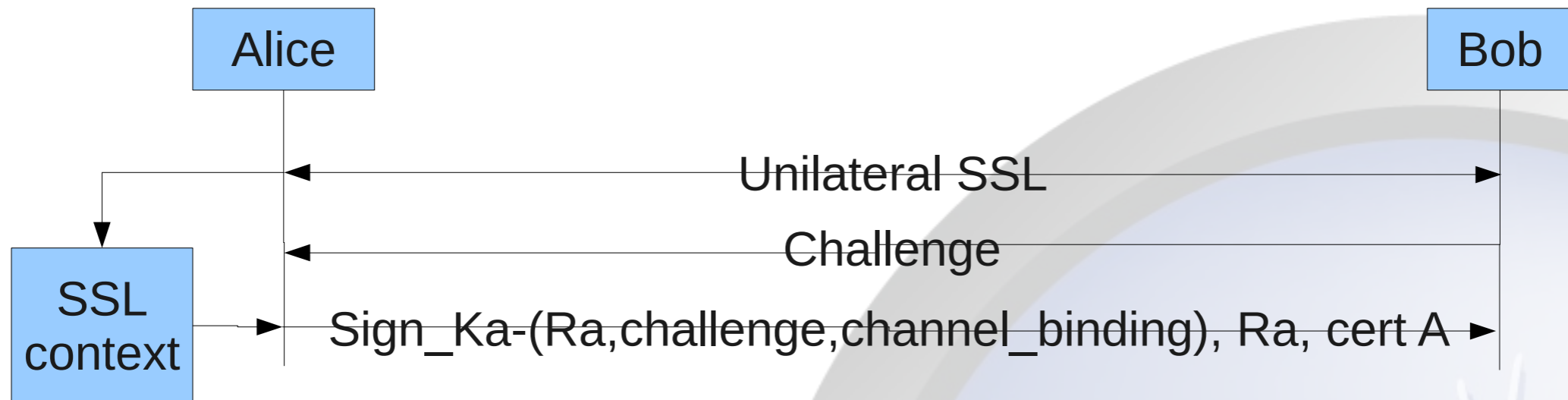
# MITM attack on SASL



- Mallory can abuse the authentication token of Alice
- Why is this going wrong?
  - SSL:  $\text{sign\_Ka}(\text{handshake\_msgs})$  so the signature digests parts of the secure channel's "identity"
  - SASL:  $\text{sign\_Ka}(\text{Ra}, \text{challenge})$  does not digest any part of the secure channel's "identity".



# Secure Channel Binding



- RFC 5056: cryptographic binding
- channel\_binding =
  - Hostname B (nice try)
  - Inet address B (nice try)
  - SSL certificate B (OK)
  - SHA1(master\_key) (even better)
- A channel binding should really digest part of the channel's "identity". Alice's SSL stack must support this.

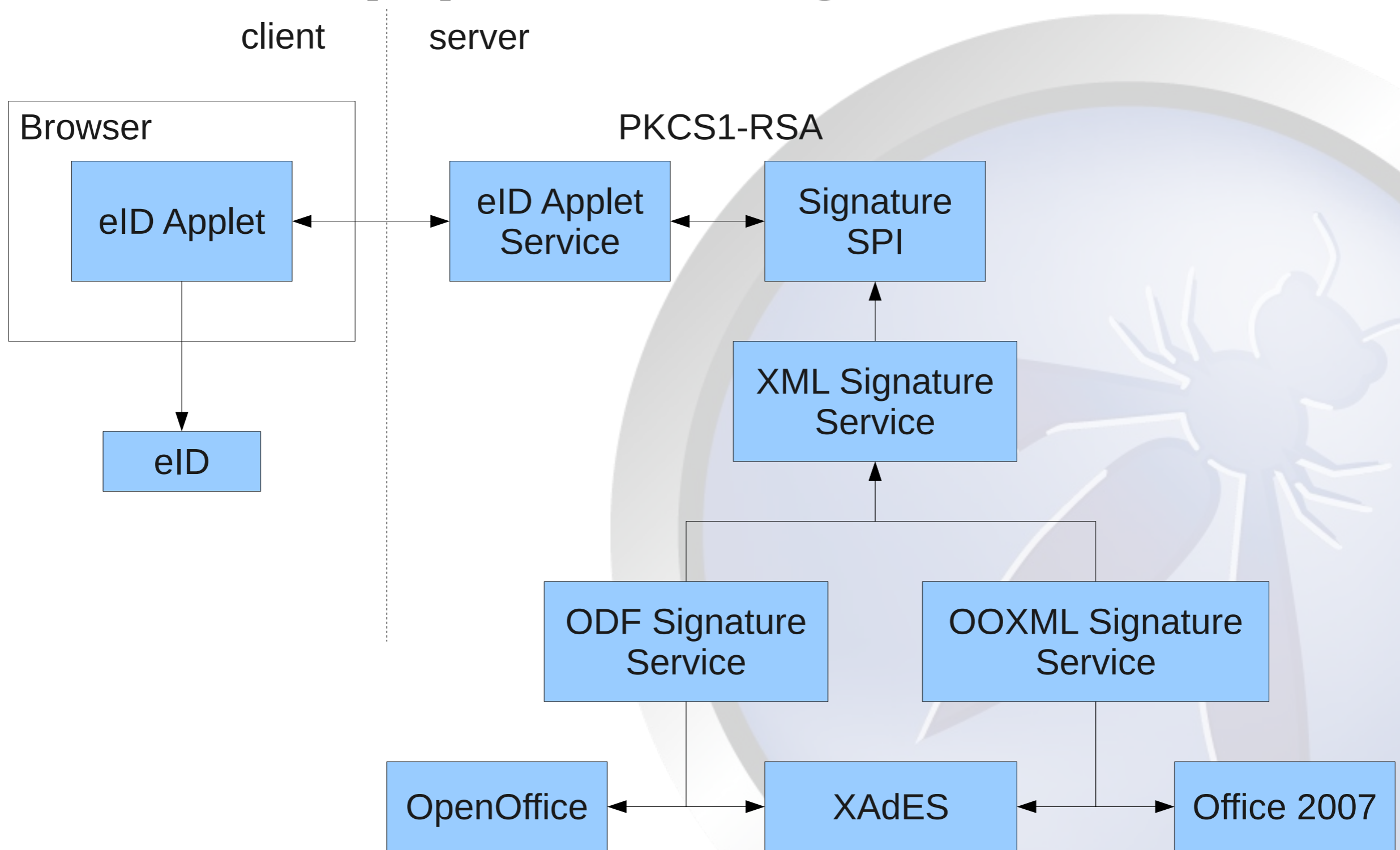


# Secure Channel Binding Demo





# eID Applet Signatures





# eID Applet Signature Demo





# Examples of Bad Implementations



# Examples of bad implementations

- Identification is not authentication
- Unsecure trust in a third party
- After successful authentication abuse HTTP
- Web vulnerabilities in an eID site



# Identification is not authentication

- Using a Java applet to retrieve first name and last name and use this for authentication => bad
- Without using HTTPS
  - Sniffing
  - MITM
  - XSRF



# Unsecure trust in a third party

- Authentication occurs using a redirect or intercept by reverse proxy
- To forward credentials to web application, an insecure mechanism is used
- HTTP Header contains NRN: can be spoofed, hijacked



# After successful authentication abuse HTTP

- Session cookie is used to maintain state
- Redirect to HTTP
  - Sniff cookie and spoof authentication



# Web vulnerabilities in an eID site

- Cross-site-scripting to steal session cookie
- SQL Injection ㄹ
- XSRF
- Broken authorization



Questions?

