

Information & Communication Security (WS 16/17)

Privacy Protection II

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www.m-chair.de

- Data Protection and Privacy
 - Origin and definition
 - Law, Technology, Standardization
- Technical Privacy Protection
 - Communication systems
 - Transaction systems
- Concepts of Privacy Protection
 - Privacy by Design (PbD)
 - Privacy Engineering
 - Transparency
 - Usability
- Integrated Privacy Protection
 - PRIME LBS
 - ABC4Trust
 - Privacy Advisor
 - Privacy Risk Communication and Mitigation

- Reachability management
- Credential technologies
 - U-Prove
www.microsoft.com/uprove
 - Idemix
www.zurich.ibm.com/security/idemix

Identity Management as part of Reachability Management

Statement of urgency

“It is really urgent!”

Specification of a function

“I am your boss!”

Specification of a subject

“Let’s have a party tonight.”

Presentation of a voucher

“I welcome you calling back.”

Provision of a reference

“My friends are your friends!”

Offering a surety

“Satisfaction guaranteed
or this money is yours!”

RMS Question

The subscriber wishes to be informed of your identity before the call could be connected.

Katrin Rannenberg's RMS requests for your identity:

◆ Id: ☒ none
Damker [DS 97], Herbert
Damker, Herbert
Pseudonym Harry Hurtig (P)

RMS Question

At the moment the subscriber can only accept urgent calls. Please decide!

Katrin Rannenberg's RMS requires an answer to the request above:

☒ My call is urgent, please connect.
☐ At the moment my call is not so urgent.

Cancel Answer

[Rannenberg2000]

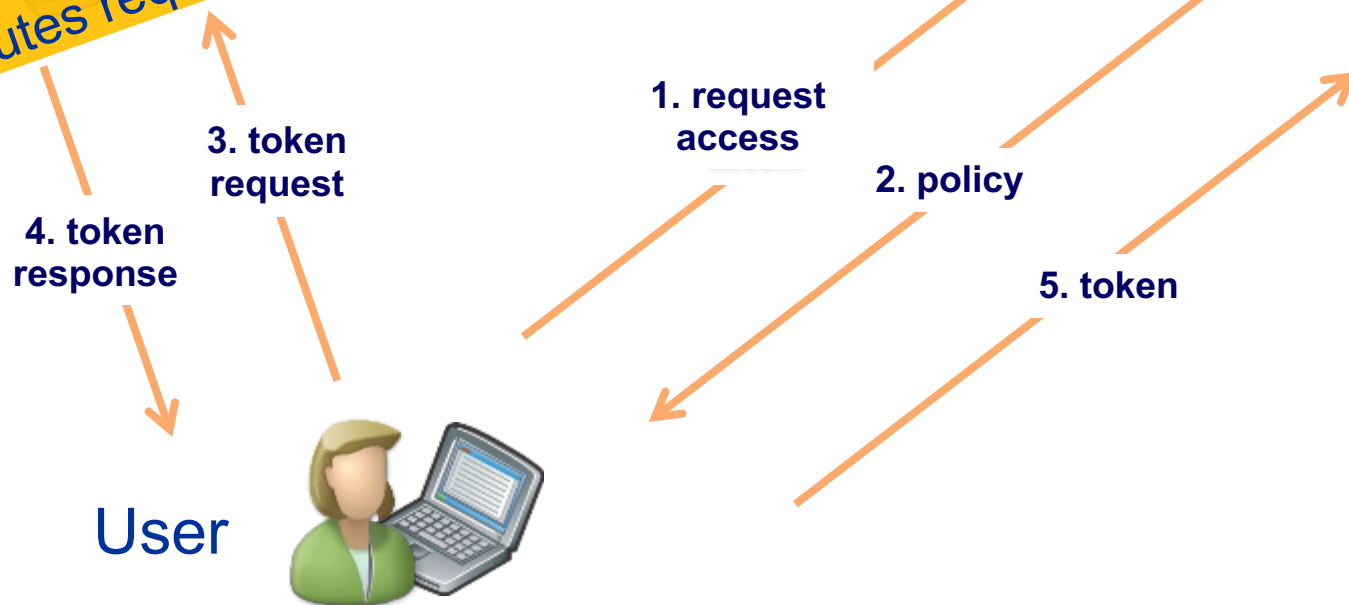
Privacy (and security) issues of typical federated IdM architectures

Identity Service Provider (IdSP)

Relying Party (RP)

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IdSP learns time of access & attributes requested.

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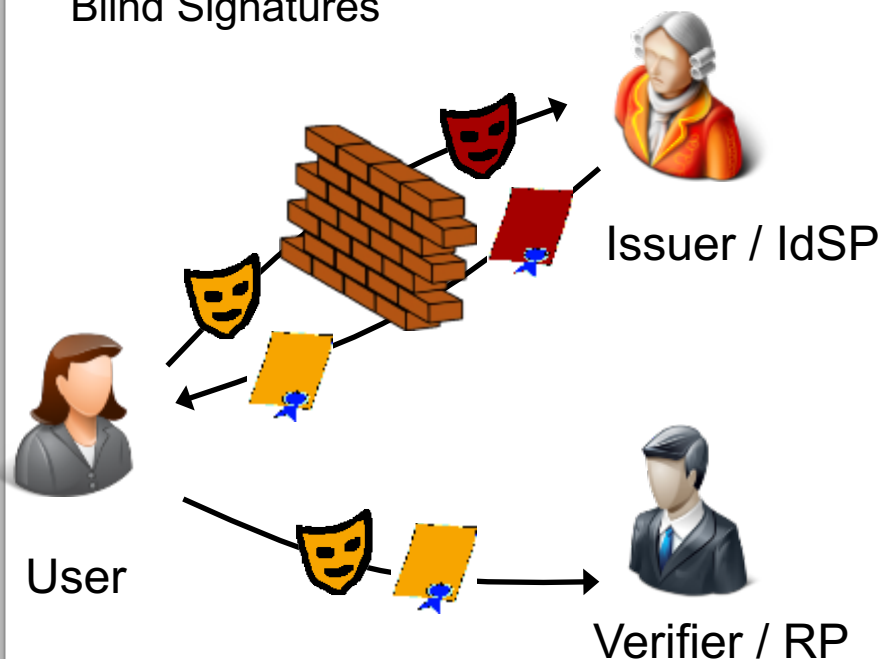


User

- Privacy features:
 - Different levels of pseudonymity
 - Selective (minimal) disclosure of attributes (attribute hiding)
 - Unlinkability of user's transactions
- Additional features are possible:
 - Prove age without disclosing birthday, e.g. for buying alcohol, showing being over 18
 - Proving of not being revoked, without disclosing the serial number in the credential
 - Predicates over attributes (no disclosure) with a constant value or another attribute
 - Inequality of attributes
 - Equality of attributes
 - Value belonging to a certain interval
 - Controlled linkability, e.g. avoid voting more than once
 - Conditional accountability, when needed

Two approaches for Privacy-ABCs

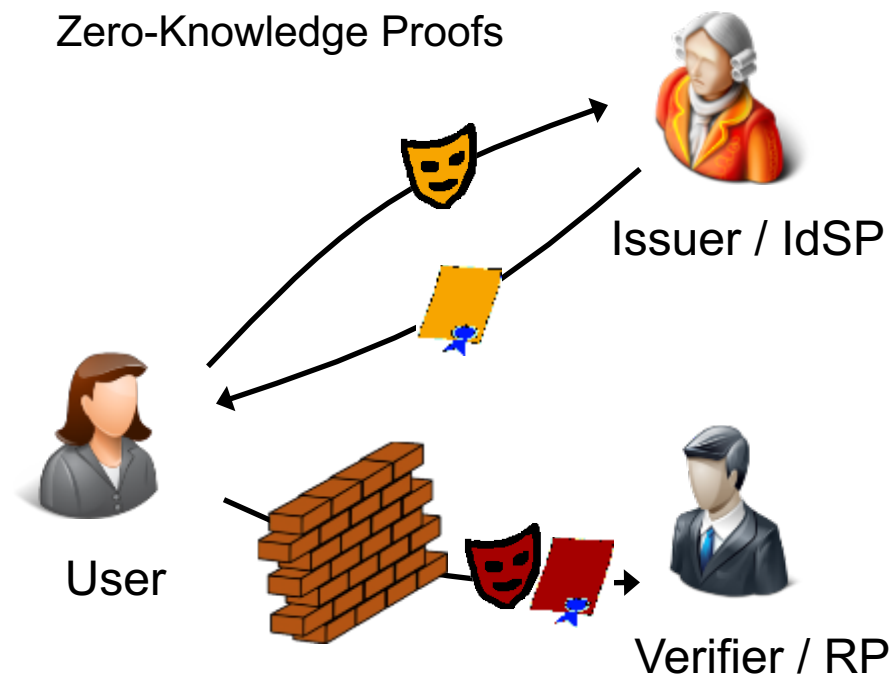
Blind Signatures



U-Prove

Brands, Paquin et al.
Discrete Logs, RSA,...

Zero-Knowledge Proofs

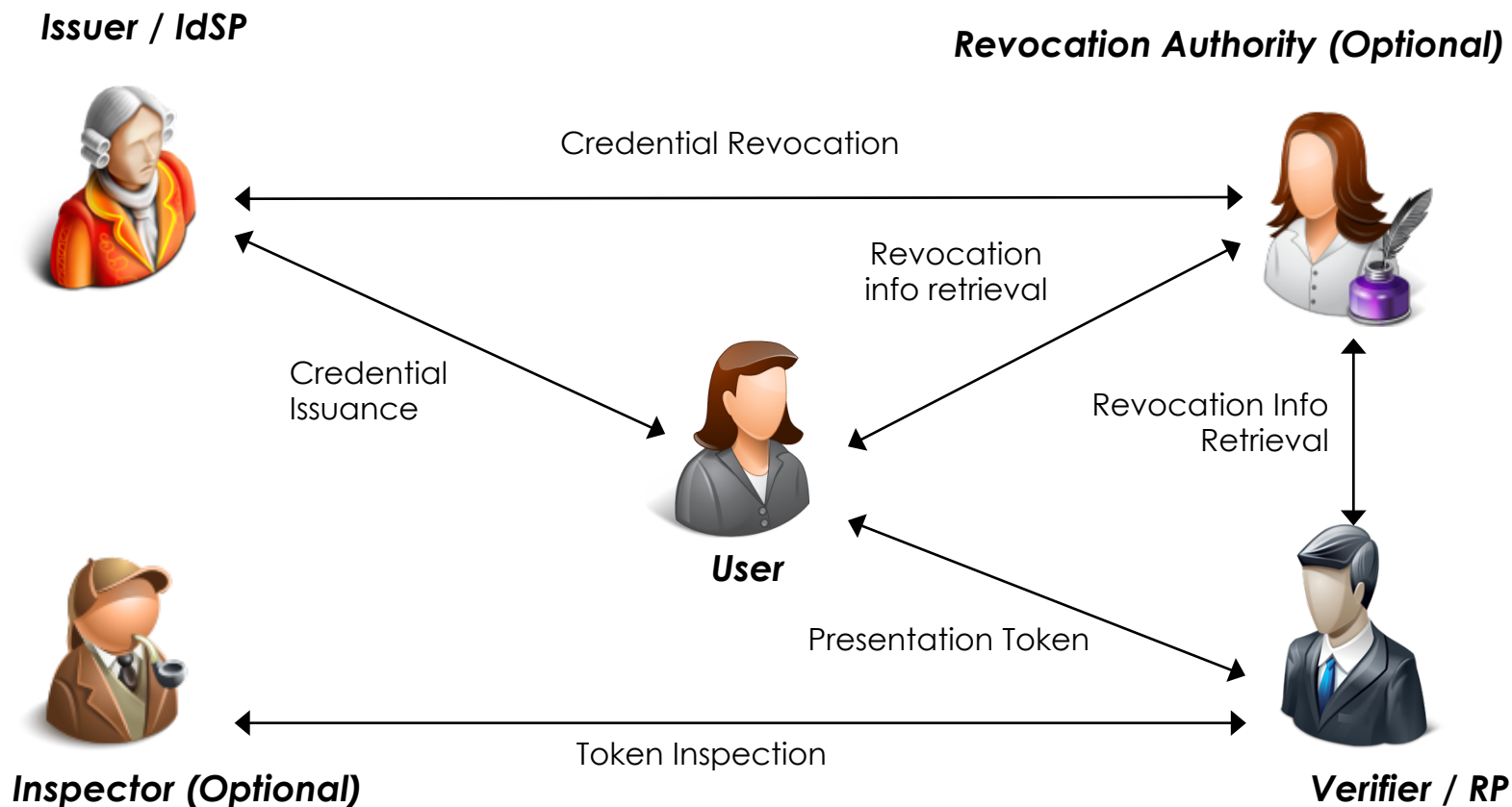


Idemix (Identity Mixer)

Damgard, Camenisch & Lysyanskaya
Strong RSA, pairings (LMRS, q-SDH)

ABC4Trust architecture

High level view



PETs alone are not sufficient

- Anonymization and Pseudonymization
 - Mix-Master, Onion Routing, Anonymous Payment, Anonymous Credentials
 - A myriad of techniques and algorithms
- Playing Cat and Mouse with Big Brother
 - Best example is Cookie Cooker
 - But many people do not have the time.
- Good pragmatic tool, but still no success
 - ⇒ Integrated privacy protection,
 - ⇒ Into business processes
 - ⇒ Into user interfaces

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Privacy by Design (PbD)

- PbD refers to the philosophy and approach of embedding privacy into the design specifications of various technologies.
- The concept is an example of value sensitive design, i.e., to take human values into account in a well defined matter throughout the whole process.

The 7 Foundational Principles of PbD

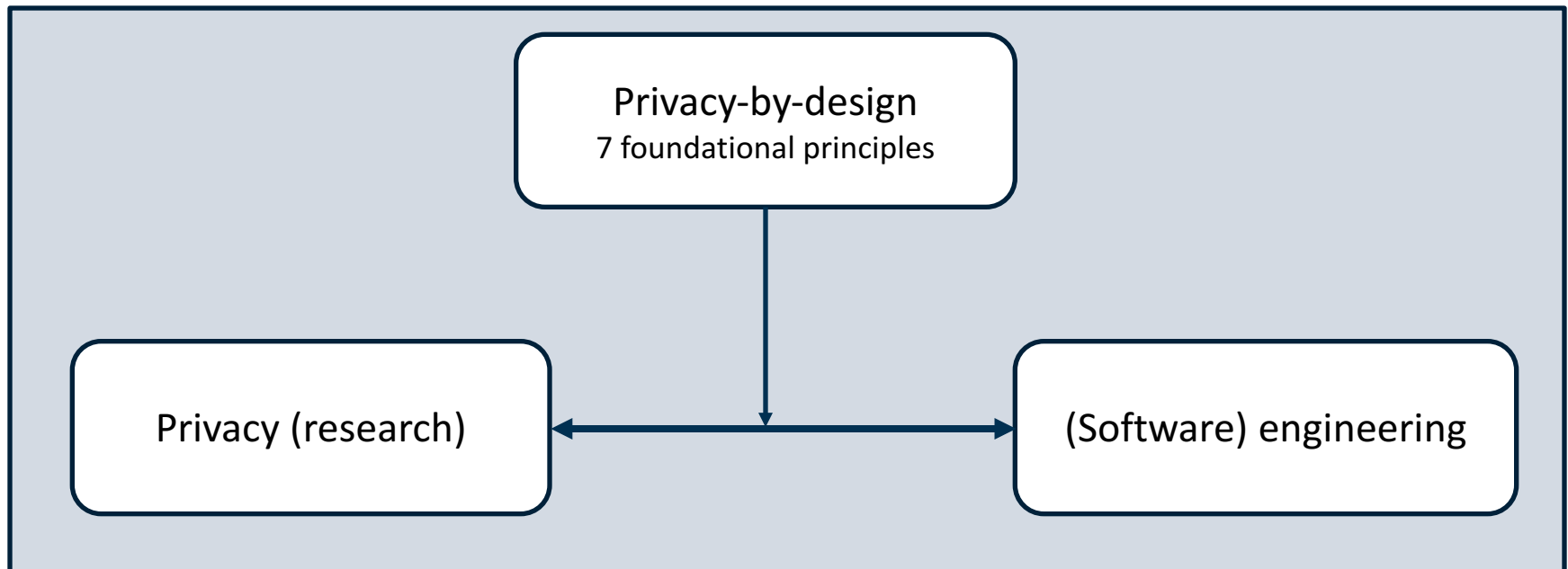
- **Proactive not Reactive:**
 - anticipates and prevents privacy invasive events before they happen
- **Privacy as the Default Setting:**
 - seeks to deliver the maximum degree of privacy by ensuring that personal data are automatically protected in any given IT system or business practice
- **Privacy Embedded into Design:**
 - embedded into the design and architecture of IT systems and business practices. It is not bolted on as an add-on, after the fact
- **Full Functionality – Positive-Sum, not Zero-Sum:**
 - Privacy by Design avoids the pretense of false dichotomies, such as privacy vs. security, demonstrating that it is possible to have both.
- **End-to-End Security – Full Lifecycle Protection:**
 - having been embedded into the system prior to the first element of information being collected, extends securely throughout the entire lifecycle of the data involved – strong security measures are essential to privacy, from start to finish.
- **Visibility and Transparency – Keep it Open:**
 - seeks to assure all stakeholders that whatever the business practice or technology involved, it is in fact, operating according to the stated promises and objectives, subject to independent verification. Its component parts and operations remain visible and transparent, to users and providers alike. Remember, trust but verify.
- **Respect for User Privacy – Keep it User-Centric:**
 - PbD requires architects and operators to keep the interests of the individual uppermost by offering such measures as strong privacy defaults, appropriate notice, and empowering user-friendly options. Keep it user-centric.

[Cavoukian2009]

Adoption of Privacy by Design

- 2010: The International Conference of Data Protection and Privacy Commissioners unanimously endorsed PbD.
- 2012: The Federal Trade Commission (FTC) in the US, proposed a framework for business and policymakers with PbD as a core value.
- 2014: The European Commission announced that: 'Privacy by Design' and 'privacy by default' will become essential principles in EU data protection rules.

- Privacy engineering is aimed to fill the gap between research and practice (between privacy and software engineering)



- Field of research and practice that **designs, implements, adapts, and evaluates** methods, techniques, and tools:
 - methods are approaches for systematically capturing and addressing privacy issues
 - techniques are procedures, possibly with a prescribed language, to accomplish privacy-engineering tasks or activities
 - tools are means that support privacy engineers during part of a privacy engineering process

- A basic principle that users must be informed about **how much** and **to which level**, and **by whom** their information is being accessed
- Users must be informed **before**, **during** and **after** the processing takes place, thus it has to cover:
 - not only the actual processing, but also
 - the planned processing (ex-ante transparency) and
 - the time after the processing has taken place to know what exactly happened (ex-post transparency)

- The solutions for providing transparency should have some important features. They should:

be
comprehensible

not be time-
consuming

be easy to use

not require a
specific user
interaction

be adapted to the
limited size of
device displays

- Usability is defined as the **extent** to which a **system, product** or **service** can be used by **specified users** to achieve **specified goals** with **effectiveness, efficiency,** and **satisfaction:**
 - Effectiveness: The user is able to achieve his/her goal.
 - Efficiency: The user reaches the goal with minimal effort.
 - Satisfaction: The user reaches the goal without dissatisfaction.

■ Usability

“Can I do what I want to do?”

Effectiveness

“Do I feel secure and comfortable while using the system? “

Efficiency

Satisfaction

“Does the system accomplish my tasks quickly? “

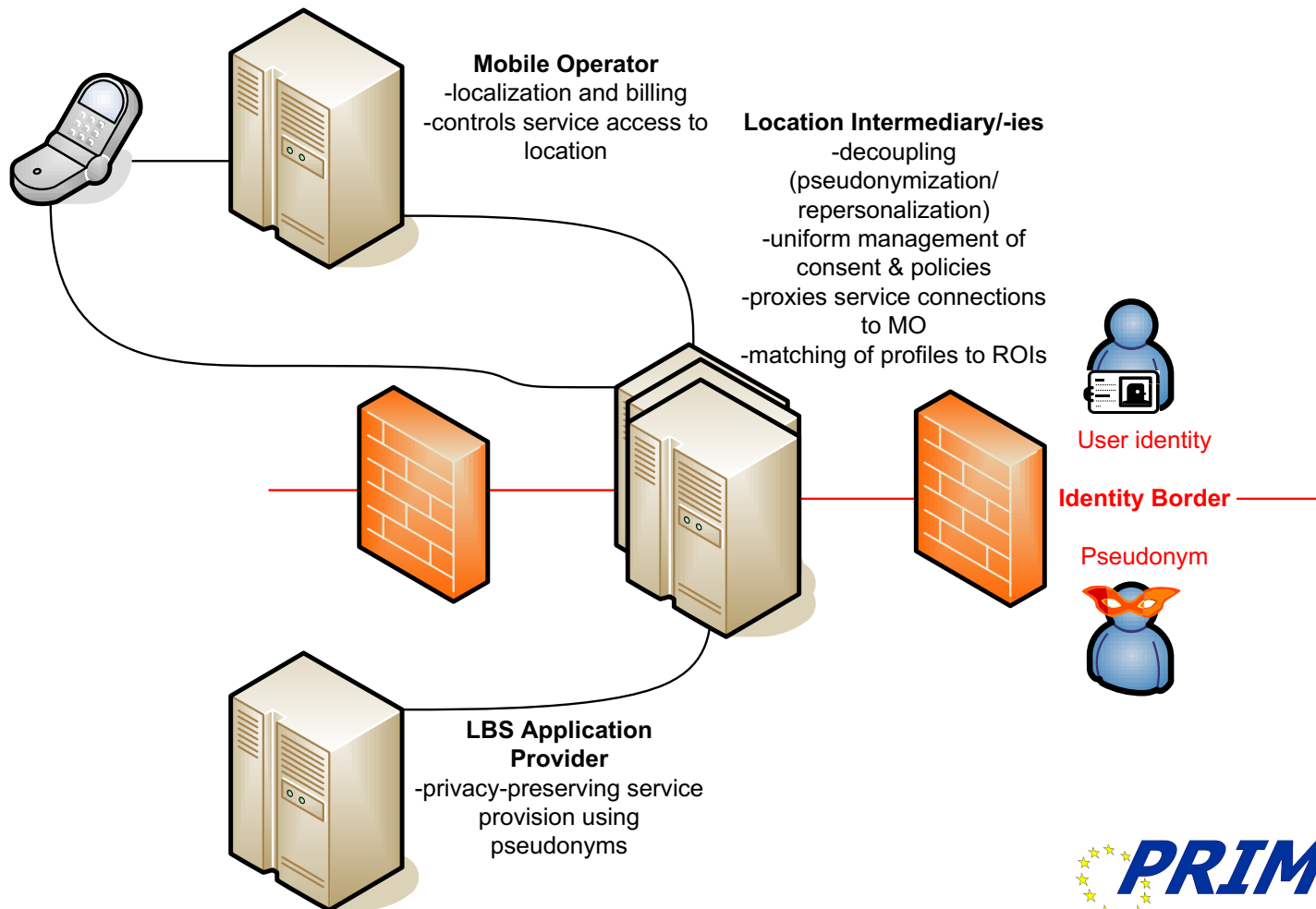
[NationalAcademy2010]

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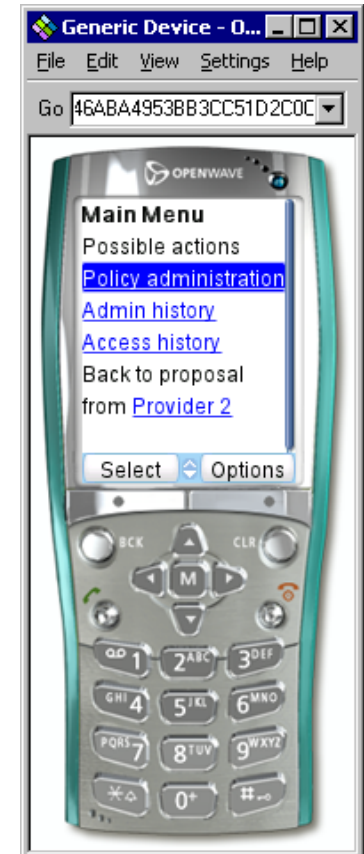
- Enhance privacy for typical LBS
 - Pharmacy search (“pull”)
 - Pollen warning (“push”)
- Address wide user range by making only few requirements on the existing infrastructure
 - Simple WAP mobile phone (Version 1), Java phone (Version 2)
- Several challenges
 - Privacy problems
 - Regulation, e.g. of the handling of personal information (and mobile services in general)
 - Business constraints
 - Easy integration into existing infrastructure
 - Applicability to a wide range of business models
 - Adaptability for different market structures

PRIME LBS Application Prototype Intermediary Approach

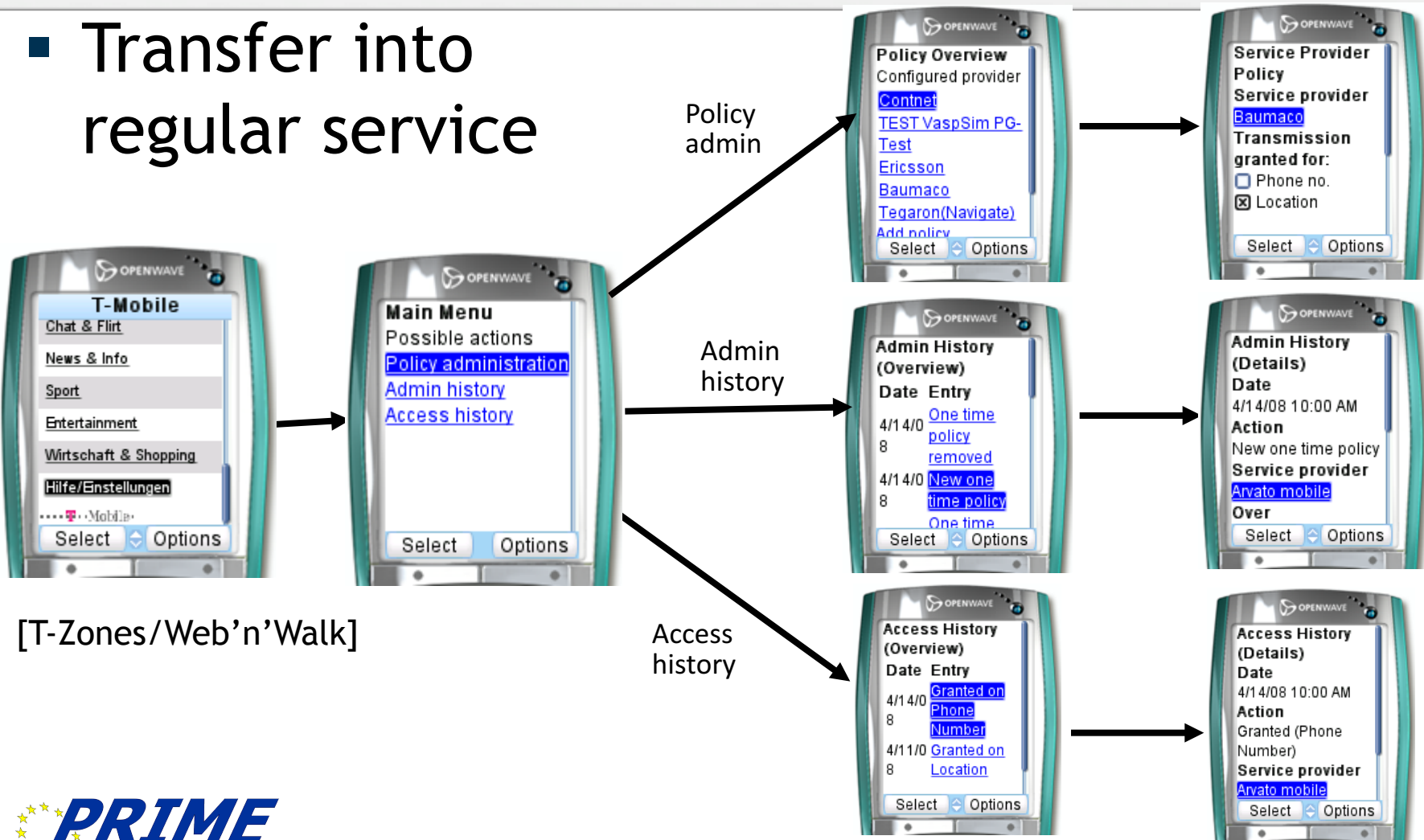
Architecture Overview



- First transfers into the “real world”
 - „Privacy Gateway“ infrastructure component deployed at T-Mobile Germany and then Deutsche Telekom
 - Allows subscribers to set
 - Which application provider gets data?
 - On which days and times?
- Request for more power on the device for e.g. maintaining one's own policies
- Computers reflect even closer one's mind, e.g. one's trust relations.



■ Transfer into regular service



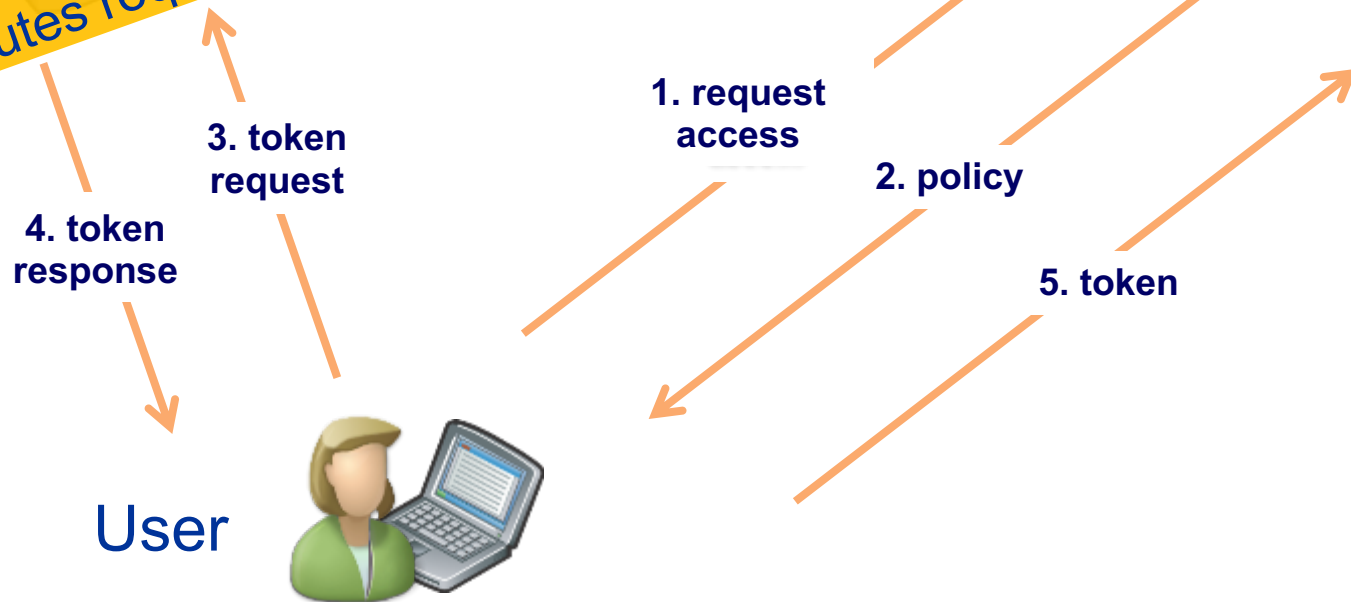
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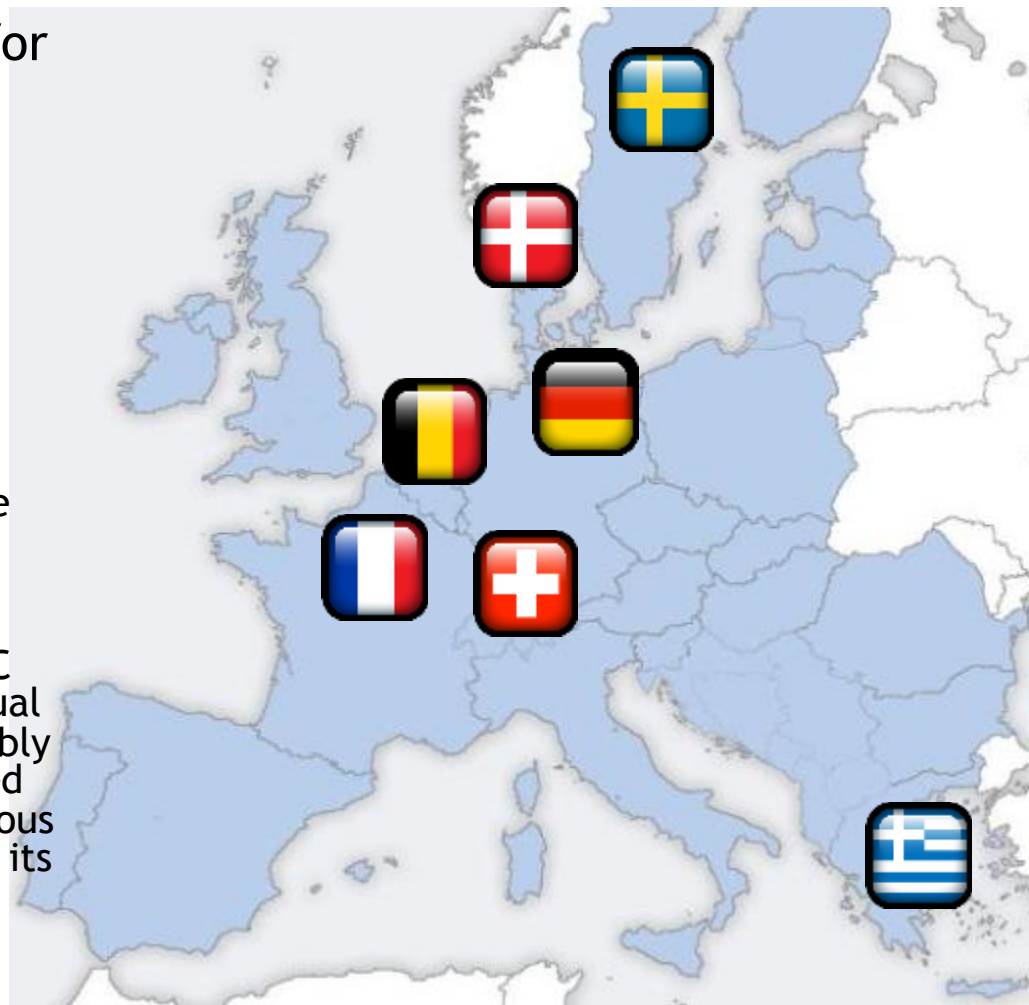
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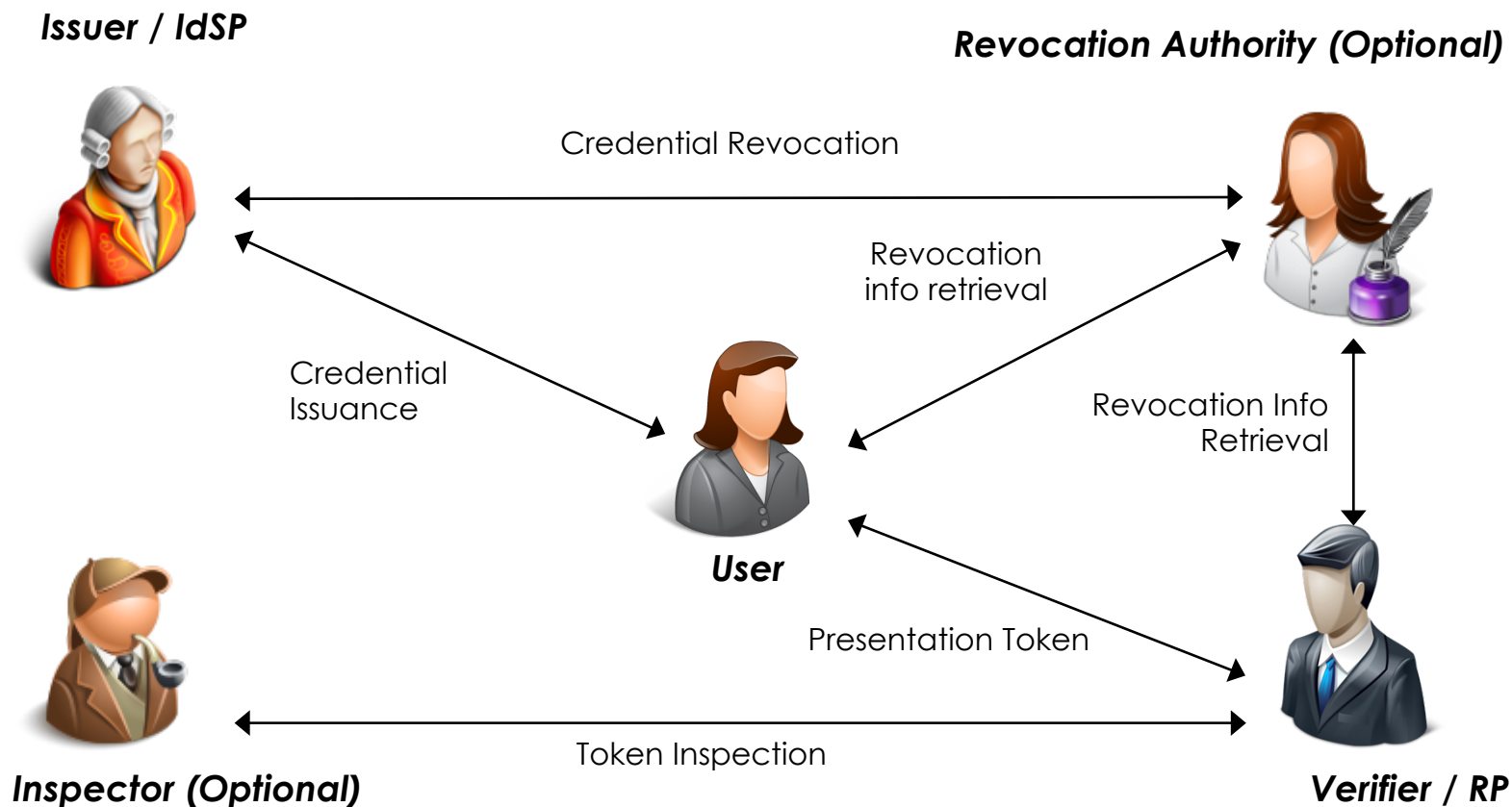


- Attribute-Based Credentials for Trust:
<https://www.abc4trust.eu>
- Coordinated by Goethe University Frankfurt
- 12 partners from 7 countries.
- Objectives:
 - to define a common, unified architecture for ABC systems to allow comparing their respective features and combining them on common platforms, and
 - to deliver open reference implementations of selected ABC systems and deploy them in actual production pilots allowing provably accredited members of restricted communities to provide anonymous feedback on their community or its members.



ABC4Trust architecture

High level view

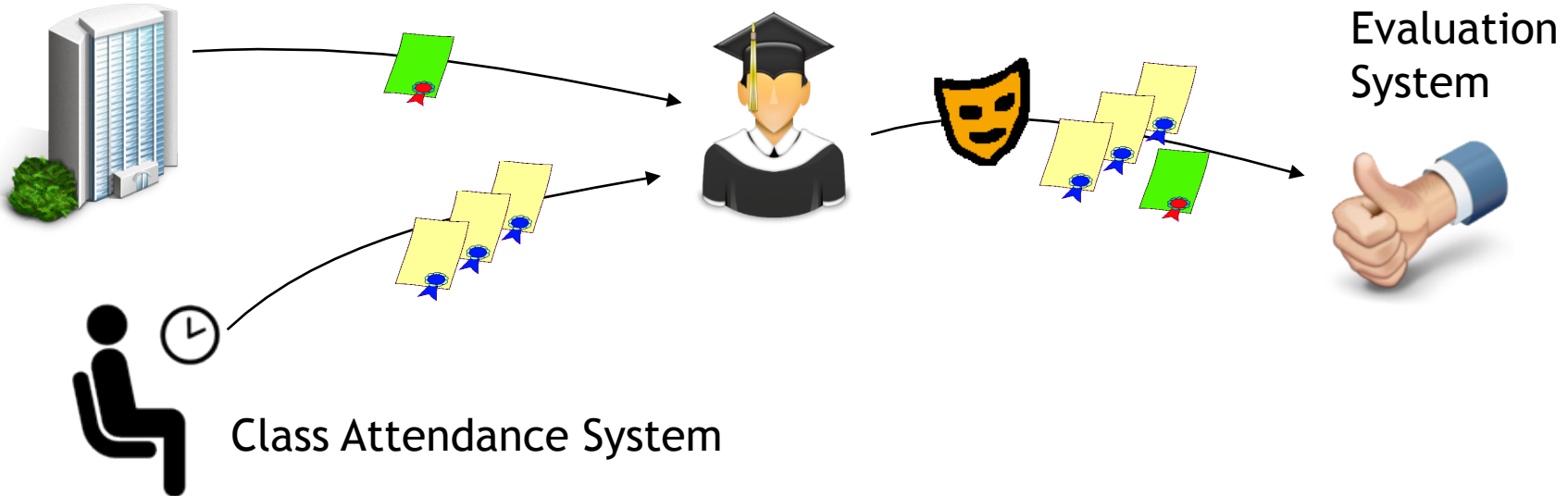


- ABC4Trust tested the technology in two pilots:
 - Anonymous course evaluation in the University of Patras, Greece.
 - Students used smartcards to collect credentials for the courses they are attending.
 - At the end of semester they were able to evaluate the course if they have attended enough number of lectures.
 - Their votes will not be linkable to their identity while the technology prohibits them from voting multiple times.
 - Privacy preserving school community platform in Söderhamn, Sweden.
 - Providing online services such as chat rooms, consultations, advices, etc.
 - Pupils satisfying certain policies based on their attributes can access certain services e.g. based on age, classroom, level, etc.

Anonymous course evaluation

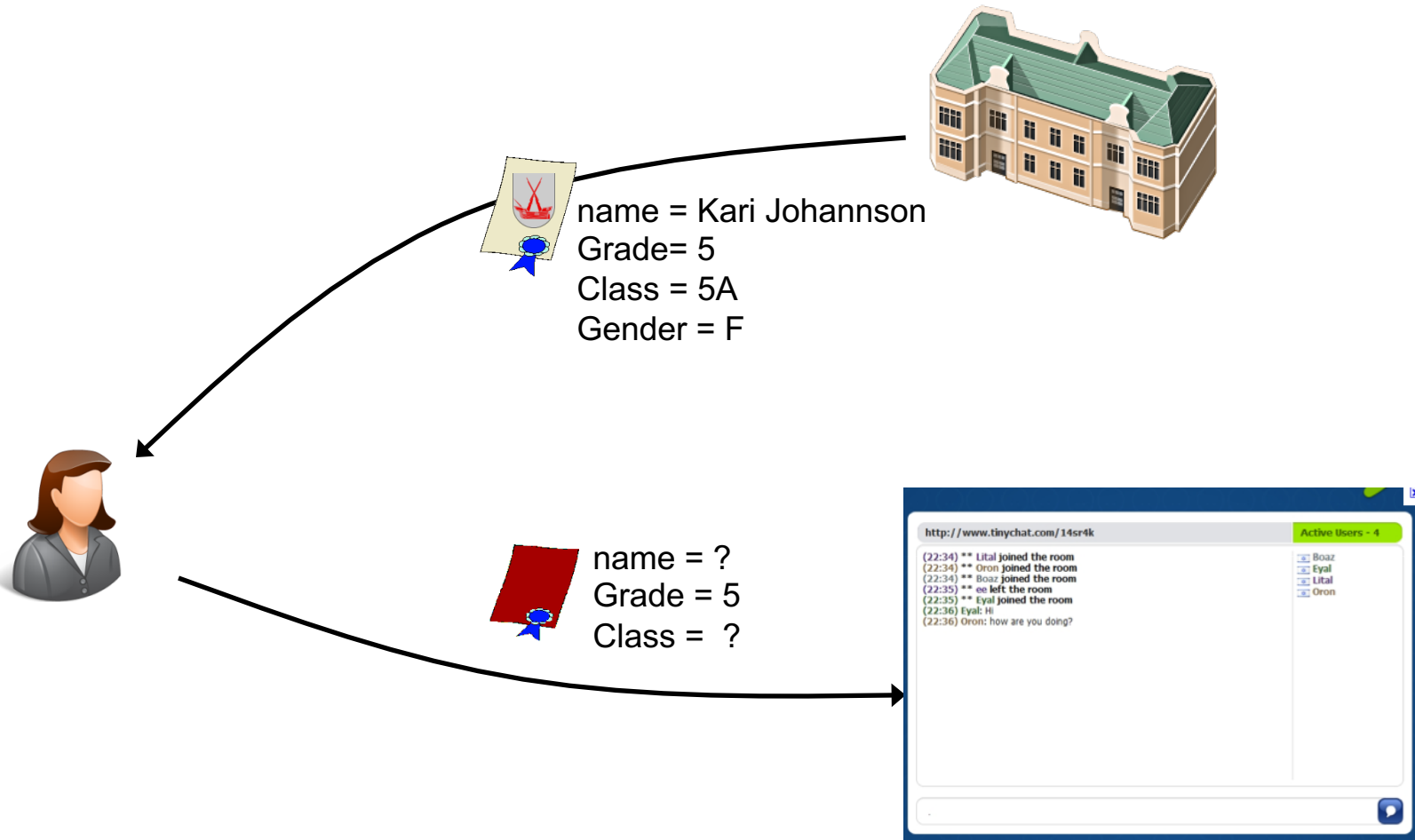
University Registration Office

Course
Evaluation
System



- ① The students receive a credential when they enroll in a course.
- ② The students anonymously collect credentials for attending each lecture of the courses.
- ③ At the end of semester they can prove that they have taken the course and participated at enough lectures to be able to evaluate the course without disclosing their identity.

Privacy preserving school community platform



Privacy Advisor on top of Privacy-ABCs

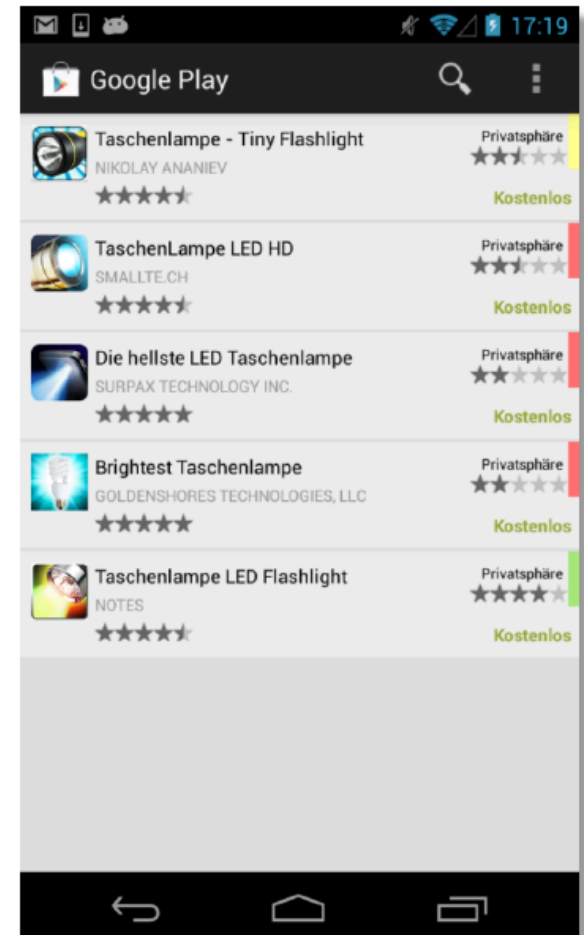
- Privacy advisor that helps users against potentially identity revelations while using privacy-preserving systems
- Automatic detection of privacy sensitive data
- Risk analysis
- Effective communication of the risk to users

Styx: Privacy risk communication method for smartphones

- **Styx Log.**
 - Information about information flows will be stored here. The monitoring component is responsible for creating new log entries.
- **Styx Pattern Collection.**
 - Since privacy impacts are modeled as behavioral patterns of apps, Styx must have access to a set of such privacy-impacting behavioral patterns in order to match application behavior with privacy impacts. Pre-defined patterns are stored in the pattern collection database.
- **Styx Pattern Detection.**
 - The actual matching between observed app behavior and PIBPs is performed by the Styx Pattern Detection engine. This component is triggered by the monitoring component after a new entry has been stored in the log
- **Styx Notification.**
 - This component is responsible for notifying the user about matches that have been identified by the pattern detection.

Benefits of privacy risk communications

- An improved privacy-risk communication leads to:
 - increased privacy and risk awareness,
 - better comprehension of risks,
 - better comparison of apps,
 - privacy as a stronger decision factor,
 - safer app choices.



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