MMEDIA 2011 Keynote Speech:

Advanced **Security** and **Reliability** Challenges for Multimedia Networks and Services

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@ **MMEDIA 2011**, April 20th - Budapest, Hungary

Hochschule Darmstadt University of Applied Sciences

h_da
HOCHSCHULE DARMSTADT
UNIVERSITY OF APPLIED SCIENCES
fbi
FACHBEREICH INFORMATIK

- Darmstadt is between Frankfurt am Main and Heidelberg.
- Hochschule Darmstadt has about **11,500** students in total.
- With about **1,200** students one of the largest Departments of Computer Science in Germany.

Breaking News:
Balatonfüred, Hungary, 15 April 2011

Neelie Kroes
Vice-President of the European Commission responsible for the Digital Agenda
Working together to strengthen cyber-security
Telecom Ministerial Conference on **Critical Information Infrastructure Protection**
Public Session Balatonfüred, Hungary, 15 April 2011:

“The EU's digital economy is **at least €500bn a year**.
That's the size of Belgium's economy, and it's growing at 12% a year.”

The new EU-US Working Group on cyber security and cyber crime as well as the Public–Private Partnerships (PPP) will focus on

“fighting botnets, security of the Domain Name System, the Border Gateway Protocol, routing tables, undersea cables and industrial control systems for smart grids.”

Agenda and Outline

- CASED IT-Security made in Darmstadt
- Research Areas [with examples and highlights]
- Research @ Hochschule Darmstadt [selected examples]

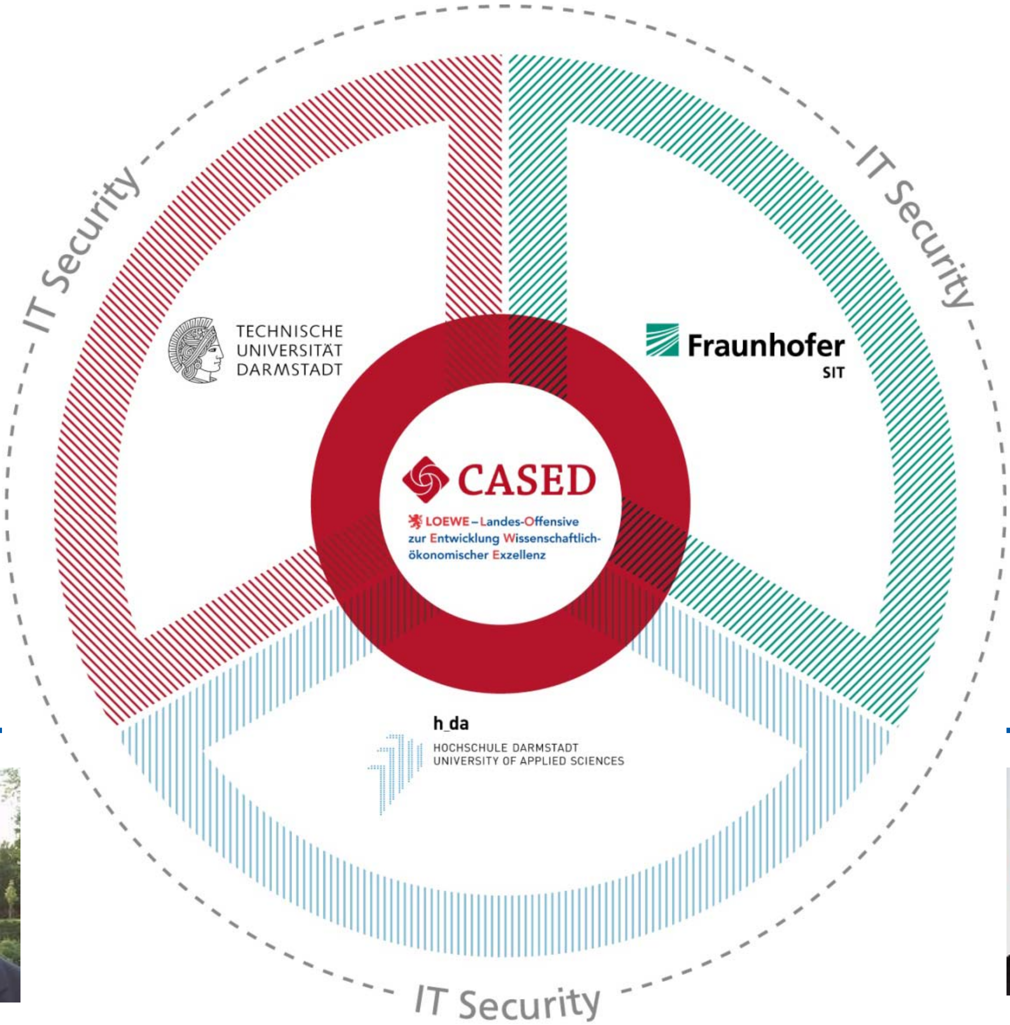
IT-Security made in Darmstadt

CASED – Center for Advanced Security Research Darmstadt

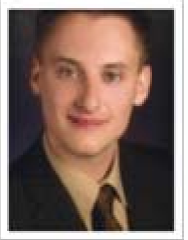
[Some advertising]

Supporting Organizations
Facts and Numbers

Three Organizations are CASED





Facts and Numbers about CASED
07/2008 – 11/2010

CASED

HESSEN Hessisches Ministerium für Wissenschaft und Kunst

LOEWE – Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz

11 Million Euro in LOEWE funding

4 Million Euro in third party funding

> 400 scientific publications

128 scientists involved (under it)

68 new Ph.D. students, 9 new PostDocs

6 new IT Security professorships at TU Darmstadt and Darmstadt University of Applied Sciences

Research Areas
[overview and some highlights]

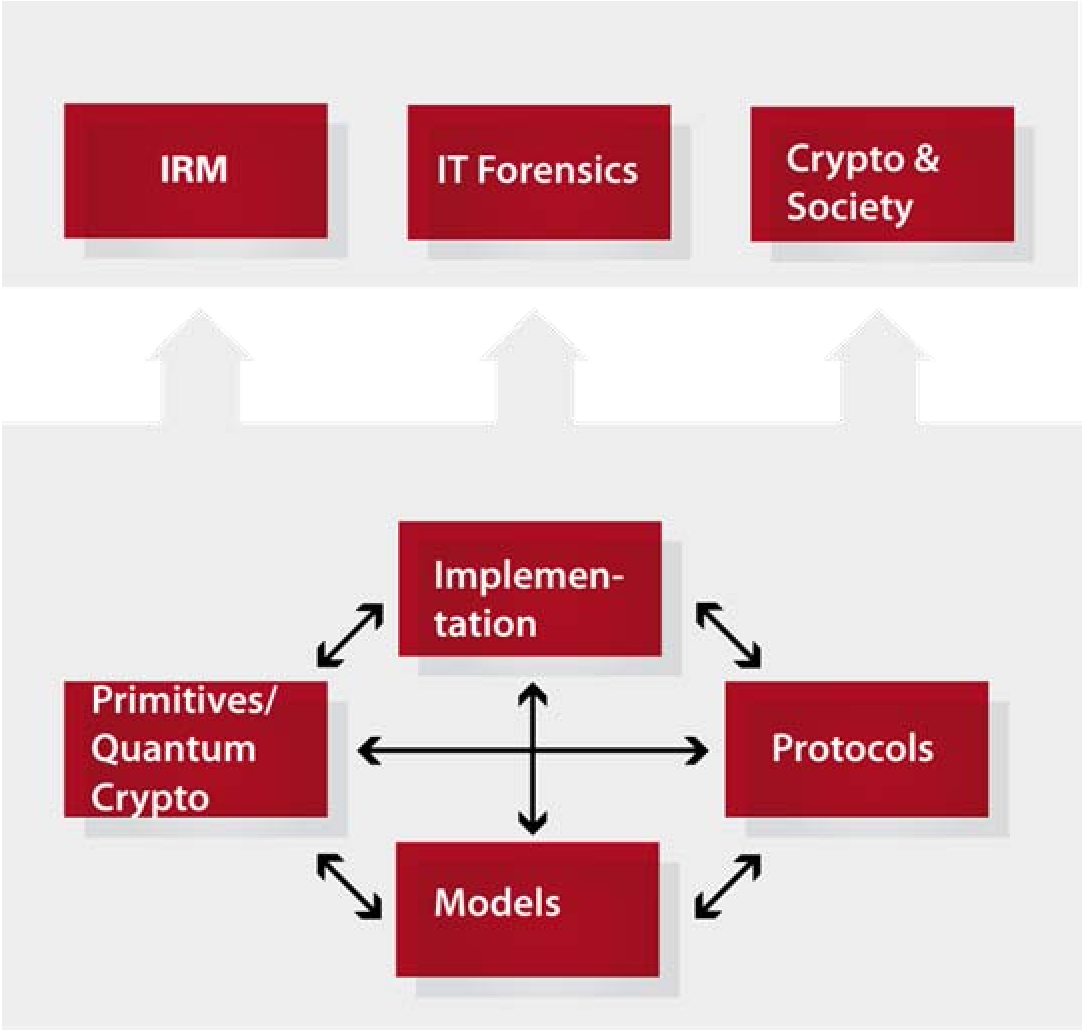
Research Areas

Secure Data

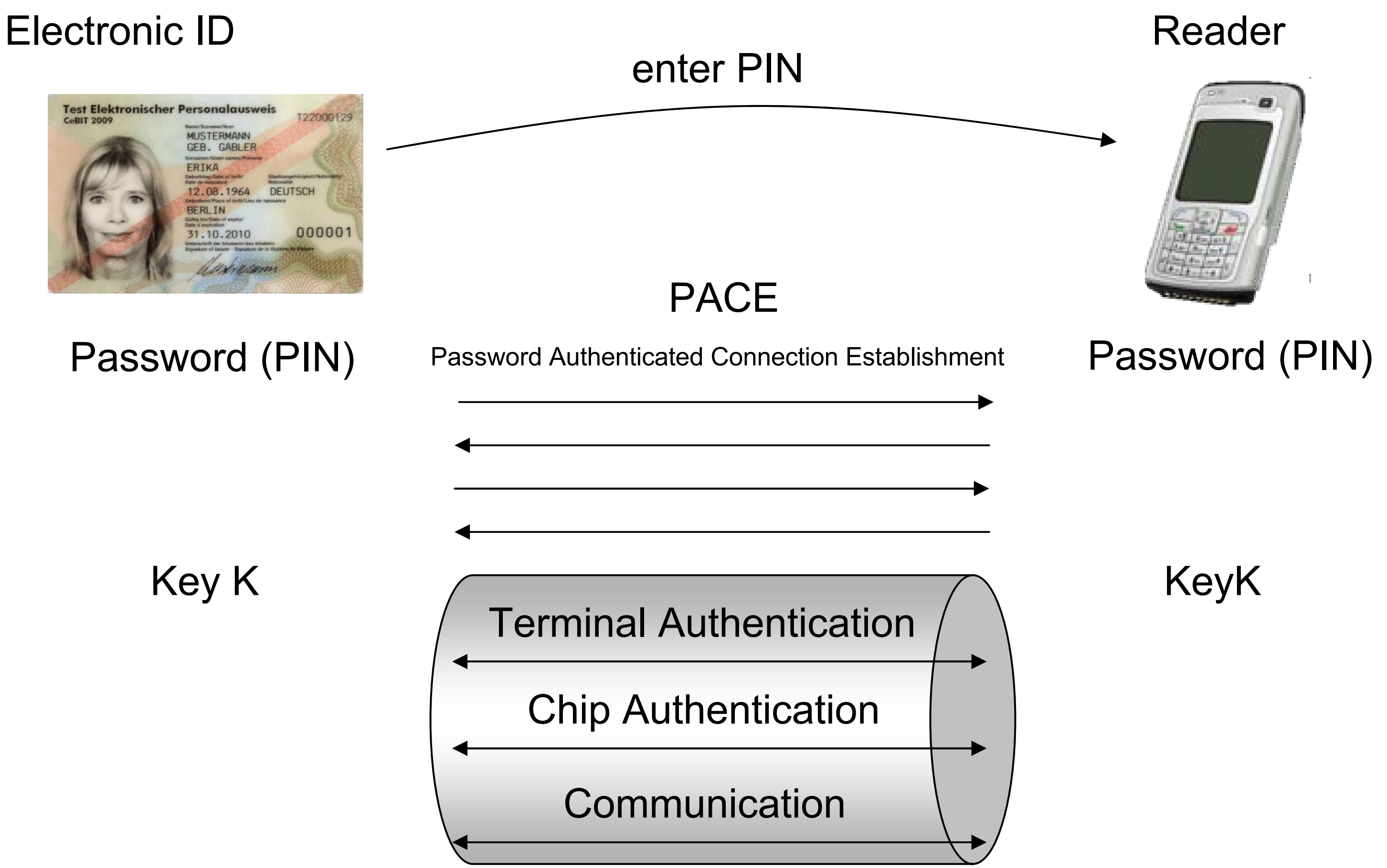
Secure Things

Secure Services

Research Area: Secure Data



Example: New Identity Cards



Research Areas: Secure Things

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Application Scenarios

- Identity and Rights Management

Application layer

- Trustworthy Embedded and Mobile Systems
- Secure Interaction of Embedded and Mobile Systems

Architecture layer

- Constructive Side-Channel Analysis
- Self-Monitoring by Security-Monitoring

Technology layer

Platform Security

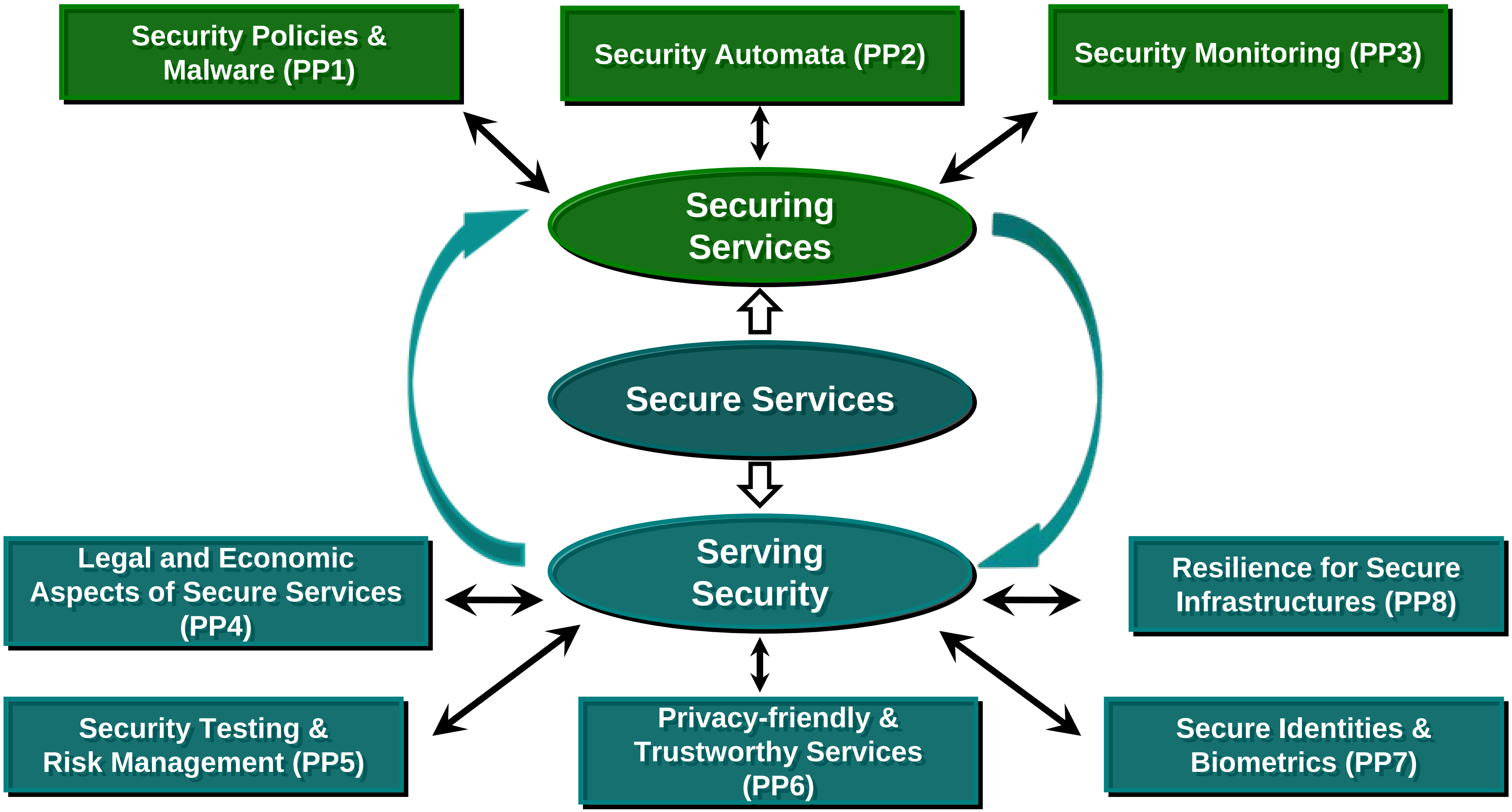
Network Security

Example:
Physically Unclonable Function

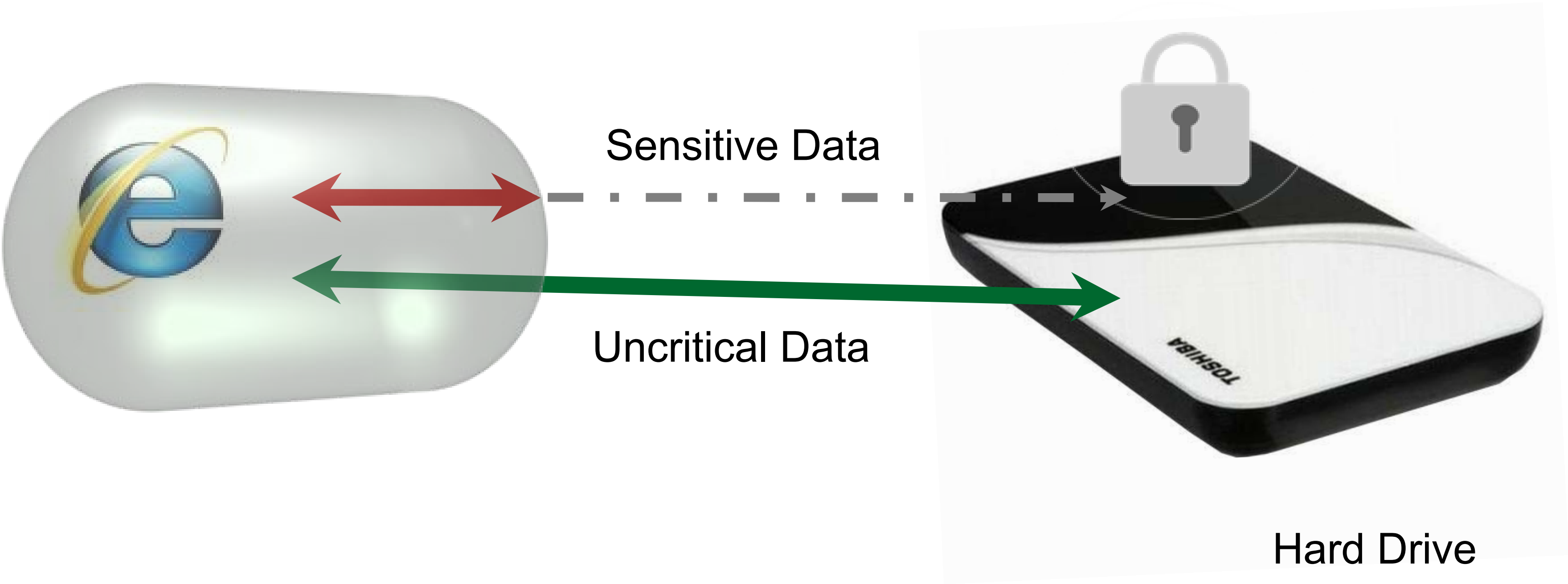
Challenge
„Who are you?“

Original card of
Max Sample

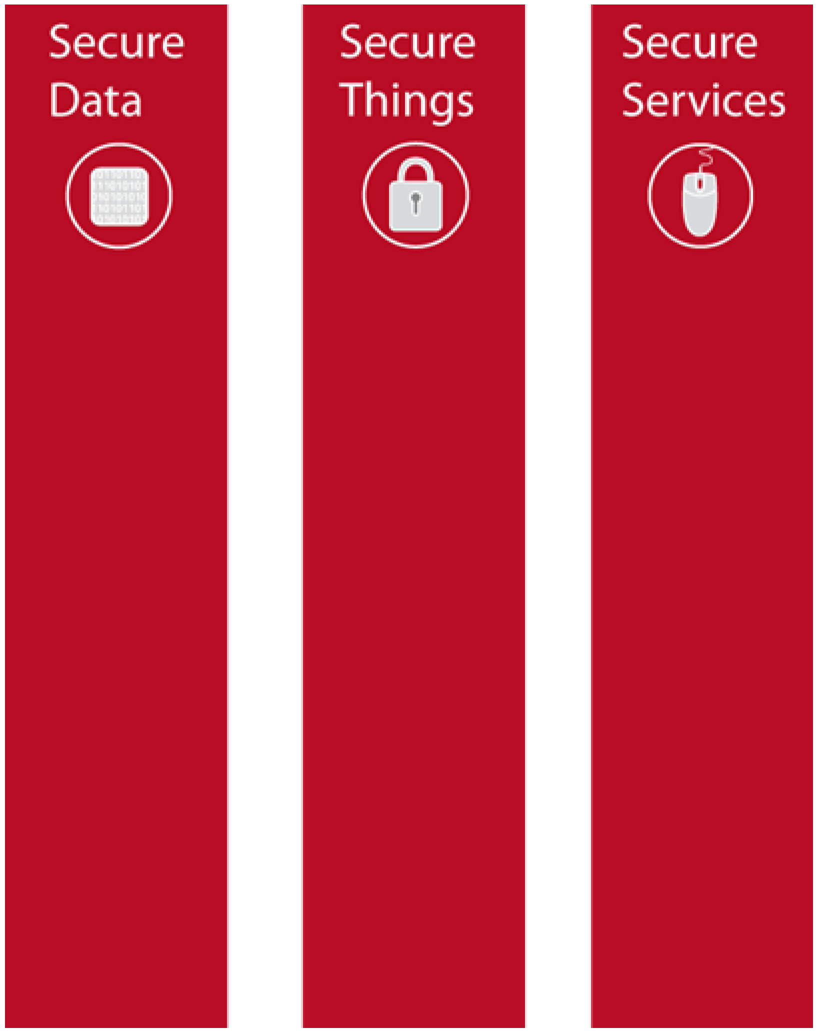
Research Area: Secure Services



Example: Encapsulation of Services



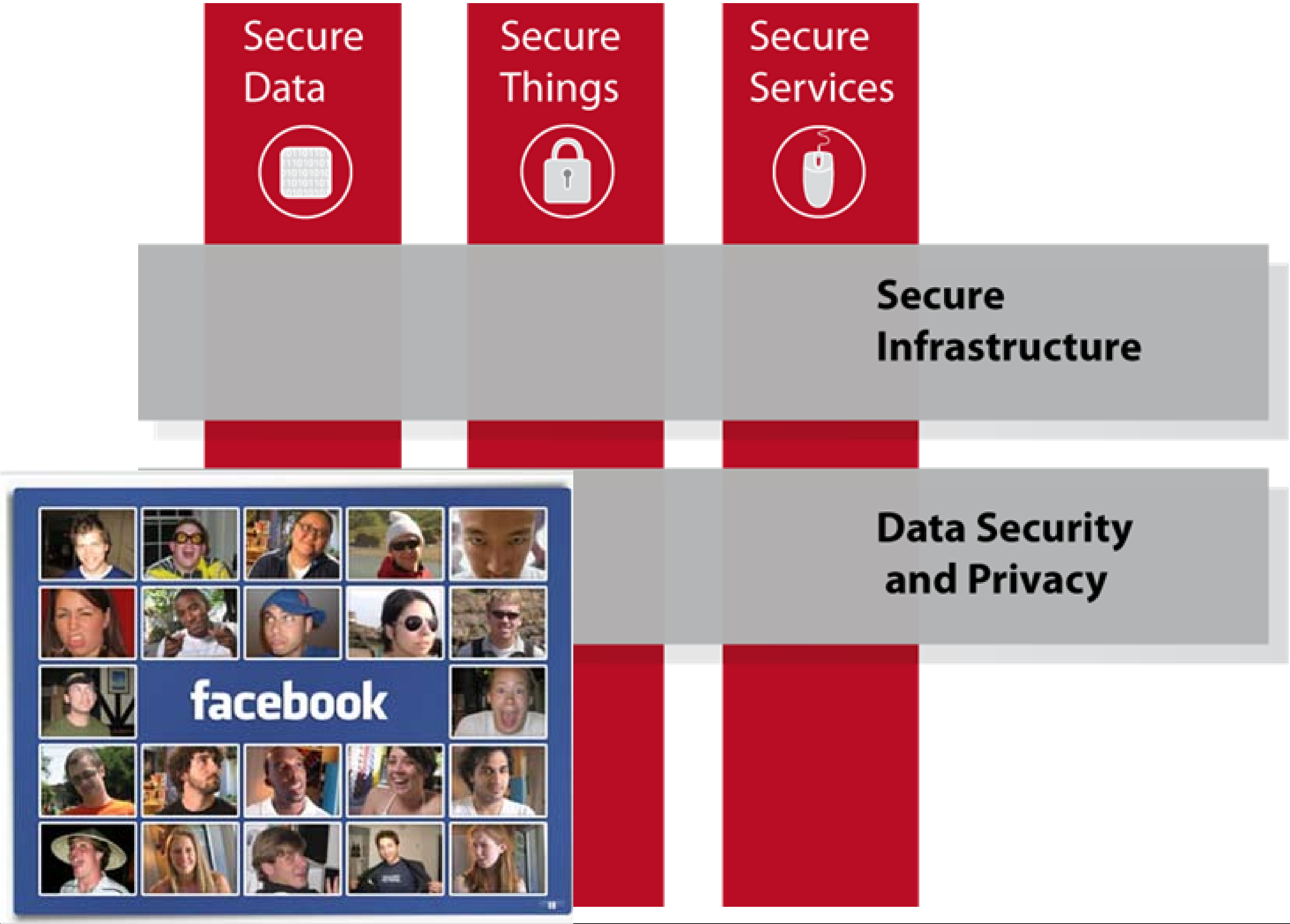
Cross-sectional Research Areas



Cross-sectional Research Areas

CASED

Cross-sectional Research Areas



Cross-sectional Research Areas

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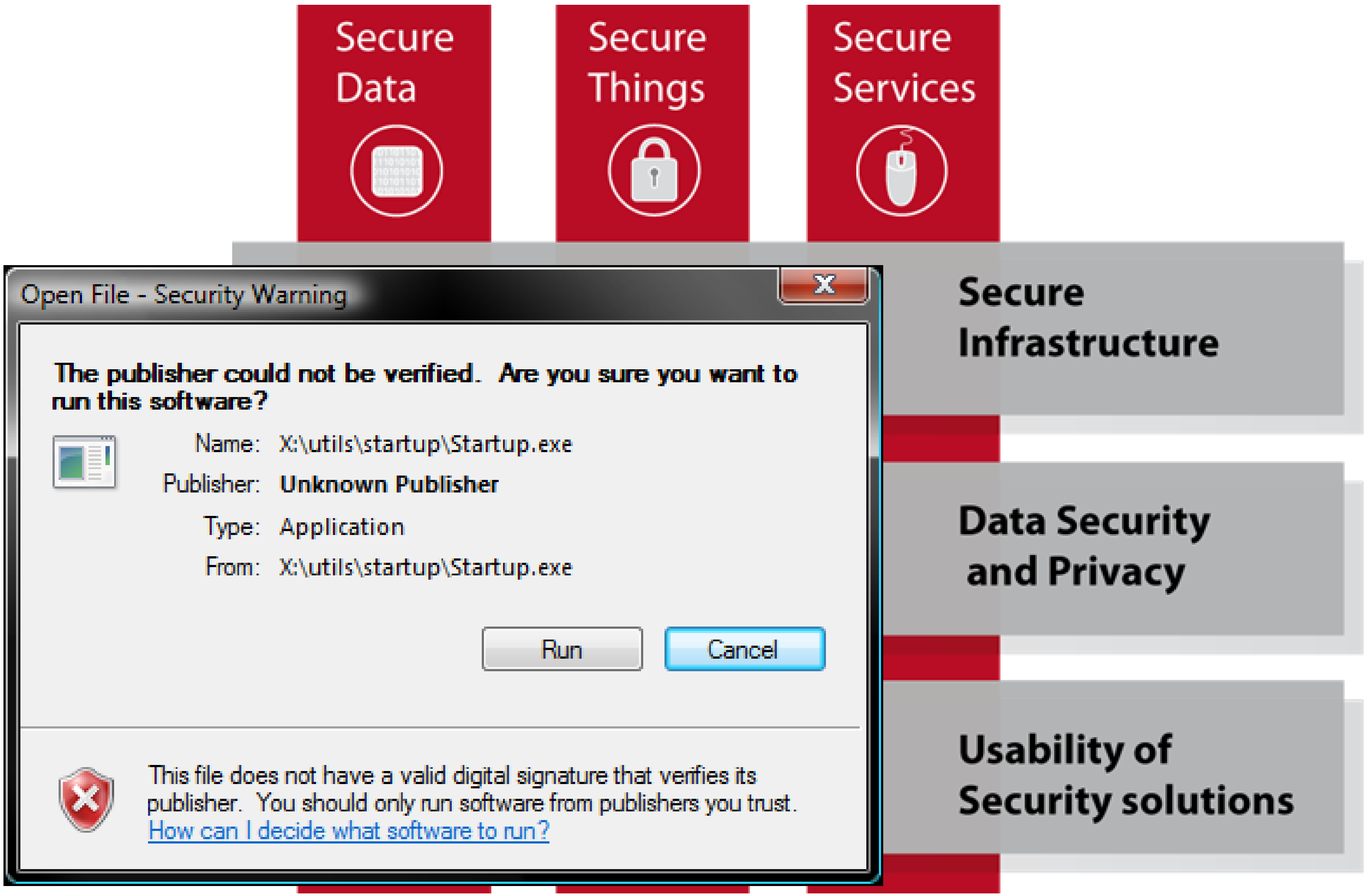
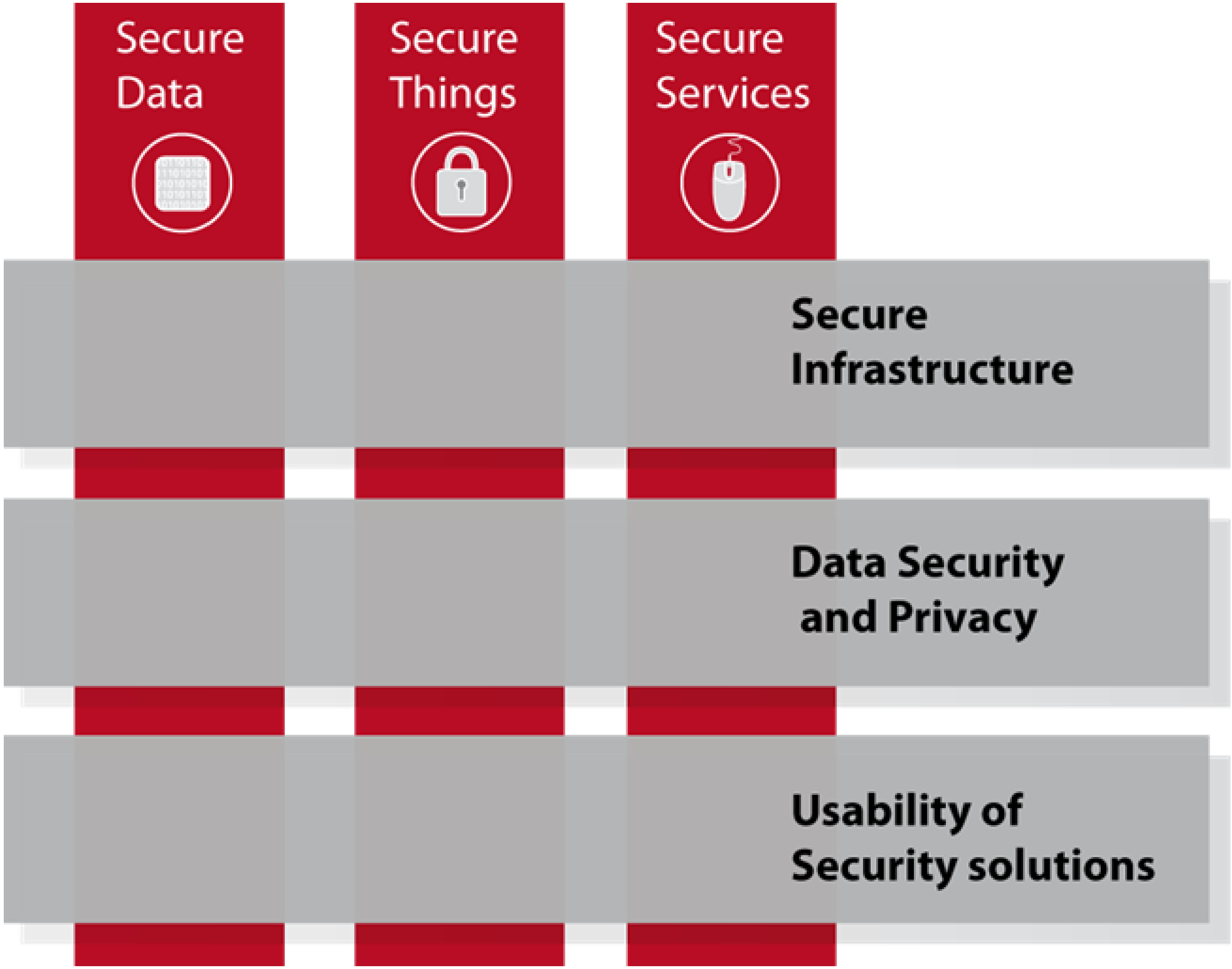


Cross-sectional Research Areas



Research Areas and Challenges

[selected examples in more detail]

Research Area 1: Secure Data

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Area

Secure Data

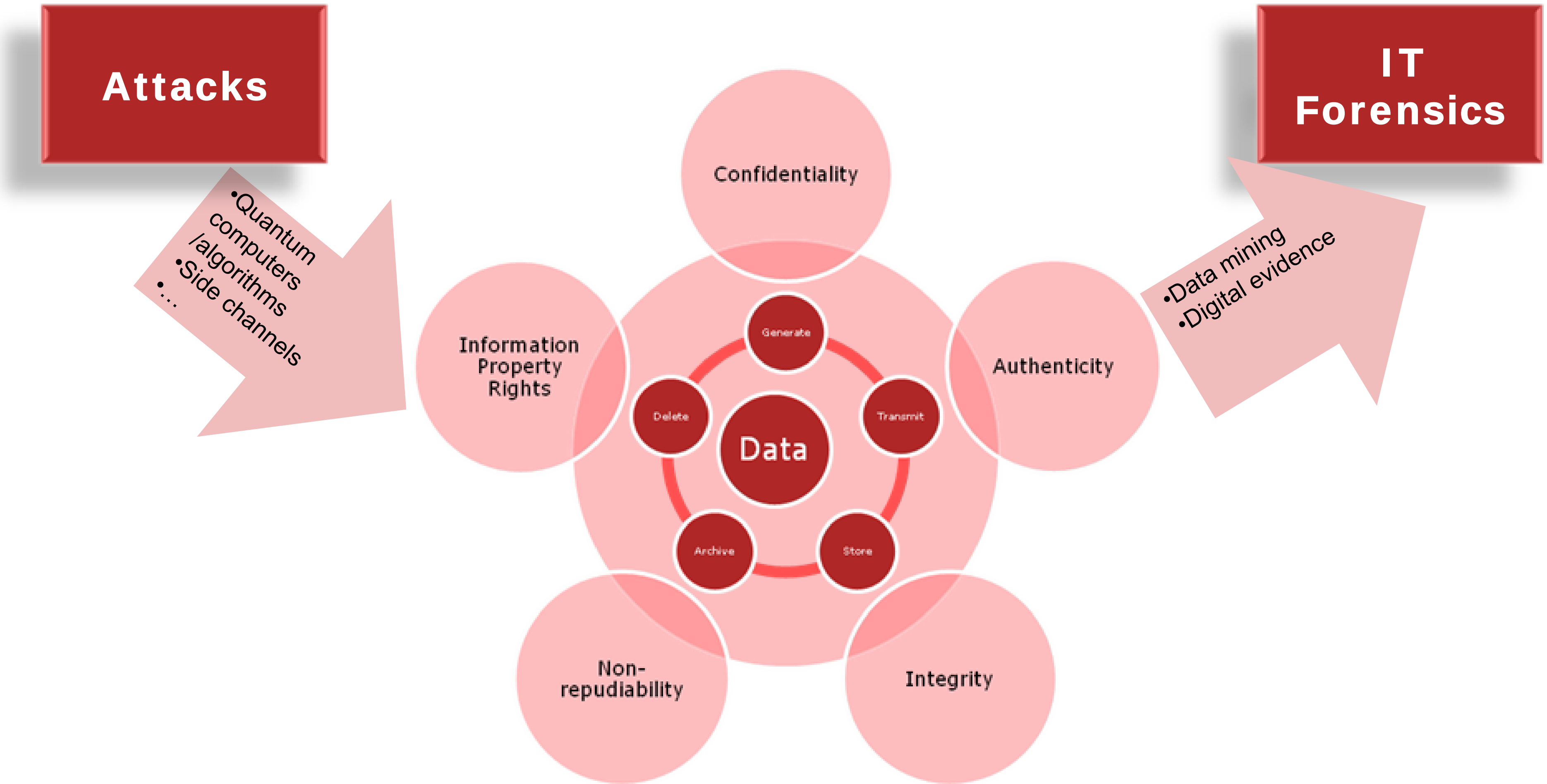
Area

Secure Things

Area

Secure Services

Secure Data: Challenges



Electronic Identity Cards / Passports

type in PIN

PACE

Password Authenticated Connection Establishment

Terminal Authentication

Chip Authentication

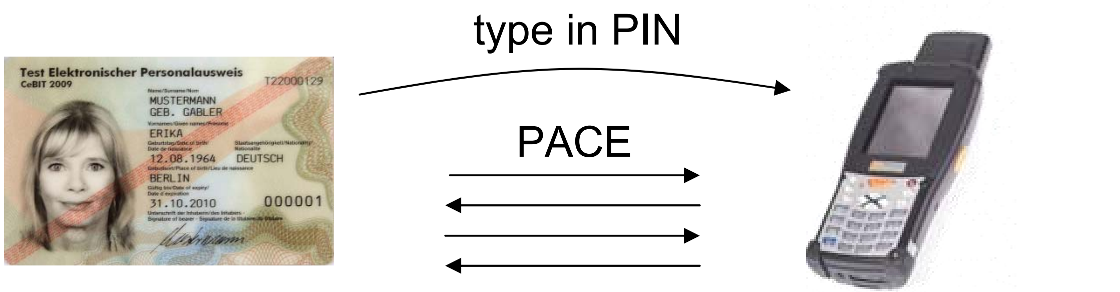
derive key K

derive key K

Communication

secured through K

Analysis of Password Authenticated Connection Establishment (PACE)



Password Authenticated Connection Establishment

- **J.Bender, M.Fischlin, D.Kügler:**
  Security Analysis of the PACE Key-Agreement Protocol,
  Information Security Conference (ISC), LNCS, Springer, 2009.

- **PACE secure in model of Bellare, Pointcheval, Rogaway (BPR) under DH-like assumption, ideal-cipher- & random-oracle-model**

Research Area 2: Secure Things

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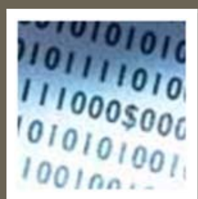
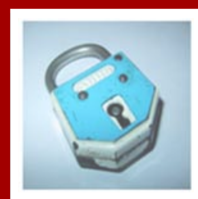
Area



Secure
Data

Area

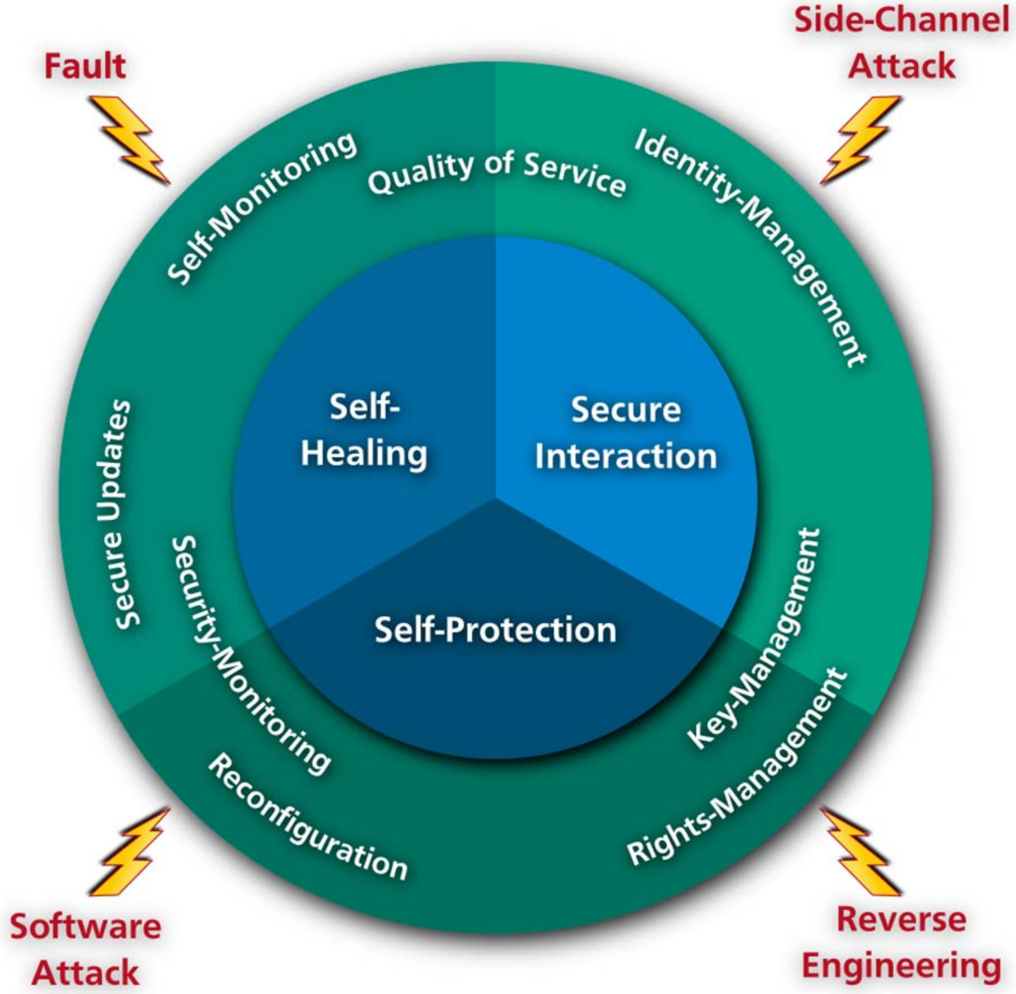


Secure
Things

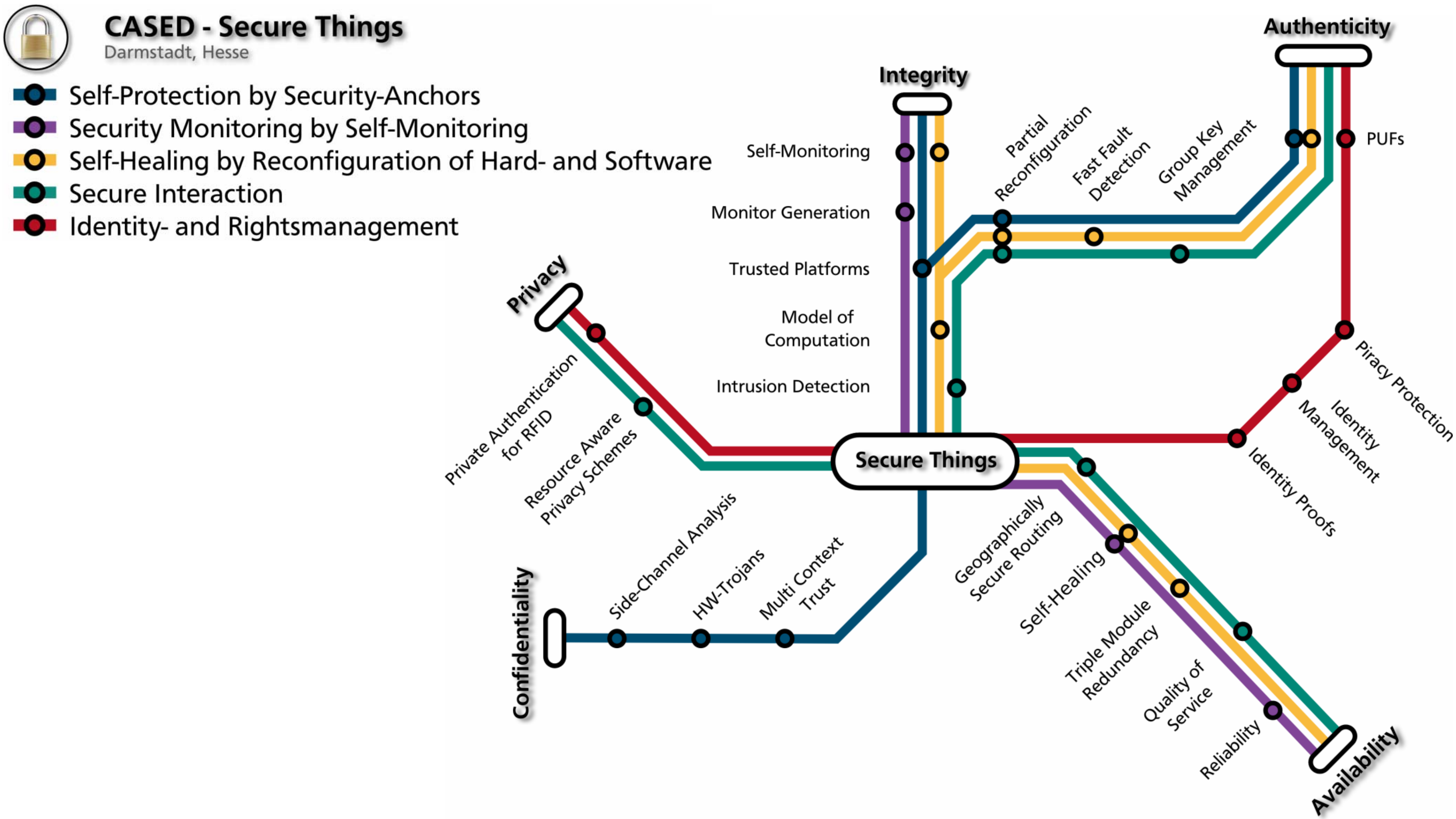
Area

Secure
Services

Secure Things: Challenges



Secure Things: Service Map



Self-Protection
by Security-Anchors

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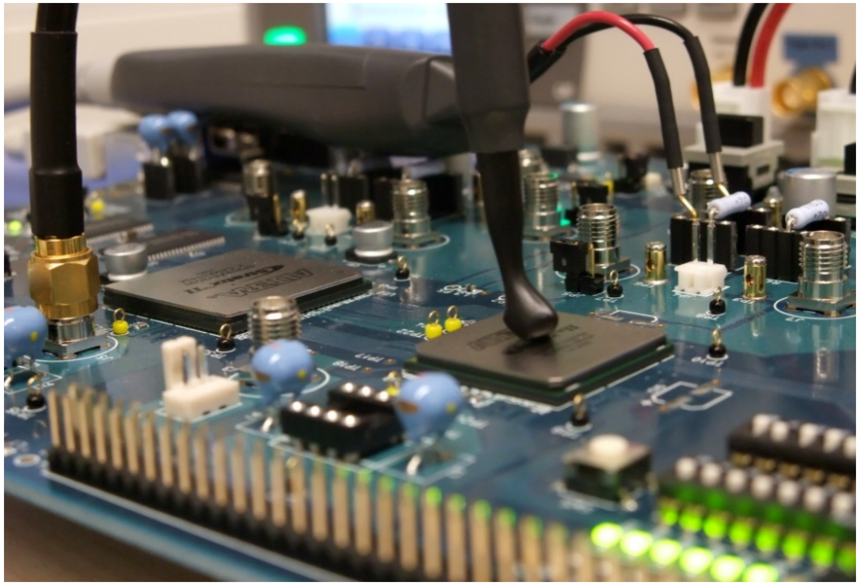
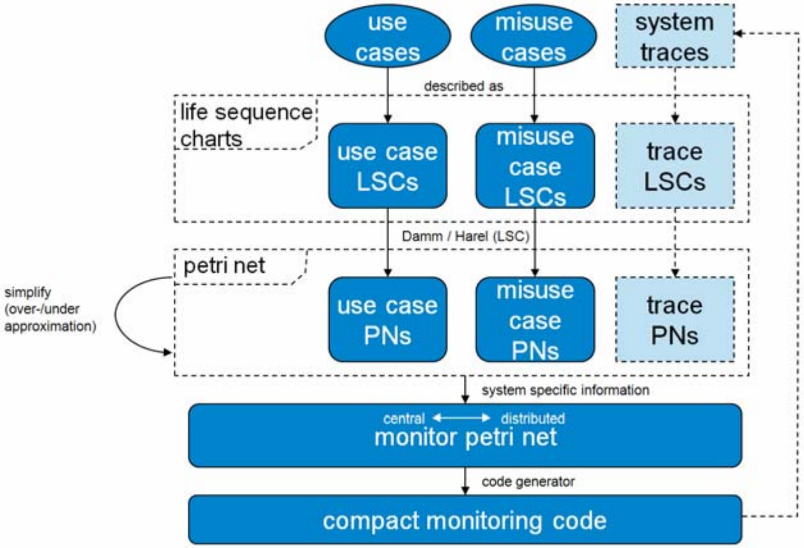


- **Side-Channel Analysis**
  - Methods for leakage detection
  - Countermeasures to harden physical devices against power attacks
  - Design methodologies to considerably reduce side-channel information leakage
  - Minimize the cost of countermeasures

- **Trustworthy Reconfigurable Architectures**
  - Building security enhanced architectures on highly dynamic structures like FPGAs
  - Trustworthy reconfiguration of embedded systems for hard- and software.
  - Secure and trustworthy update procedures
  - Flexible Trusted Platforms

Self-Monitoring
by Security-Monitoring

- **Automatic Generation of Software Monitors**
  - Modeling of requirements as complementary use and misuse cases
  - Construction of **life sequence charts (LSCs) for use and misuse scenarios**
  - Combination of LSCs into Petri nets and merging into a monitor net



- **Self-Monitoring in Embedded Systems**
  - Measurement metrics and formal modeling for state space and model mapping
  - Resource-constrained runtime threat profiling
  - Methods to determine and trigger reactions such as reconfiguration, self-healing, or restart

Identity and Rights Management

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- **Piracy Protection by Secure Authentication**
  - Identification of faked products, protection of Intellectual Property (IP)
  - **Intellectual Property protection** by means of **Physical Uncloneable Functions**
  - Development and implementation of lightweight authentication mechanisms
  - Authenticity check of RFID tagged products
- **Exchange of Identity- and Authorization-Proofs**
  - Consideration of secure the near field communication (NFC)
  - User-friendly security improvement for ubiquitous computing
  - Migration of chip card applications to NFC devices
  - Implementation of a NFC platform for access control

Research Area 3: Secure Services

Area

Secure Data

Area

Secure Things

Area

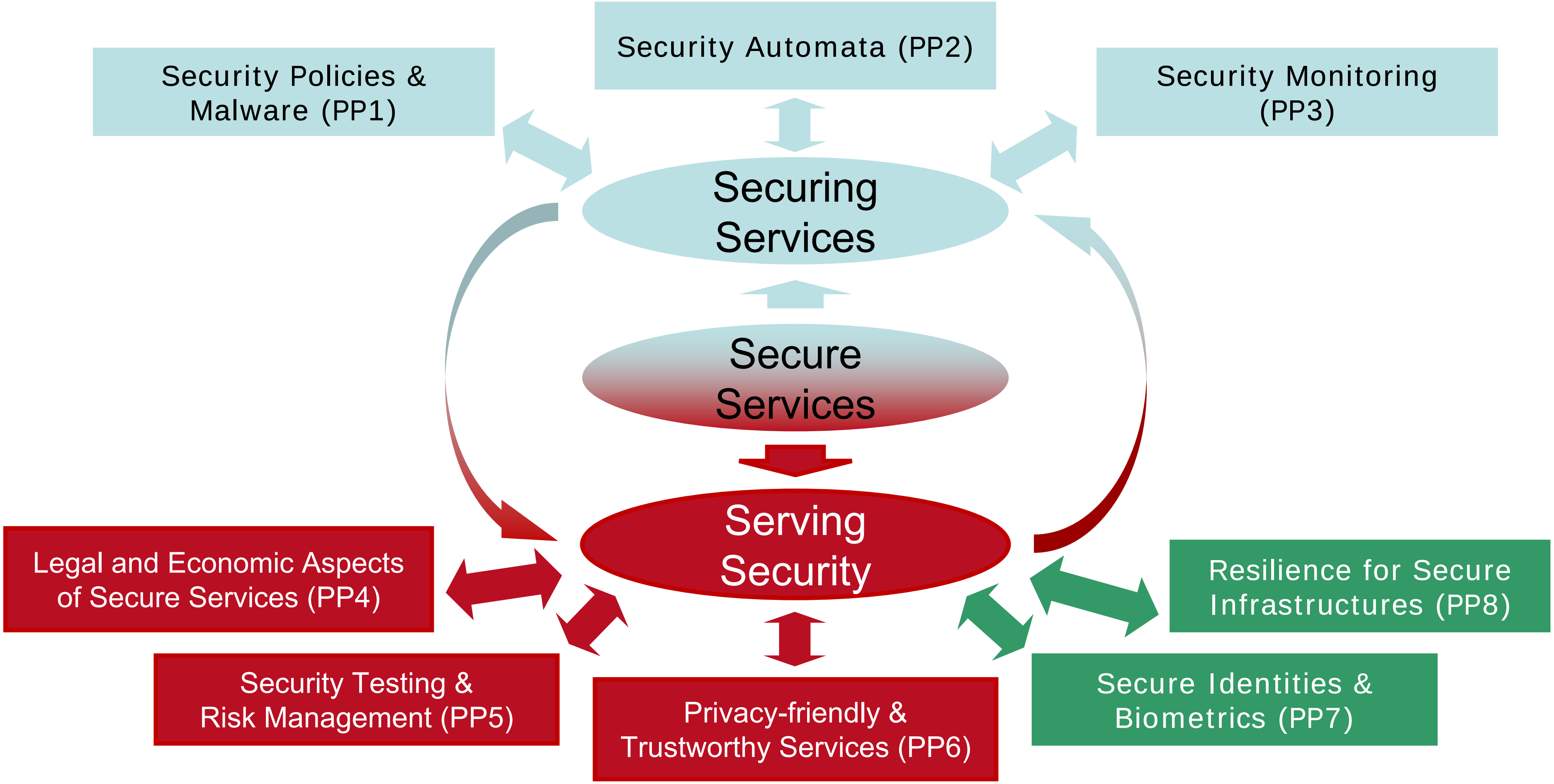
Secure Services

Secure Services: Mission

Develop technology for certifiably ***secure*** and ***trustworthy*** software components in the Internet-of-Services;

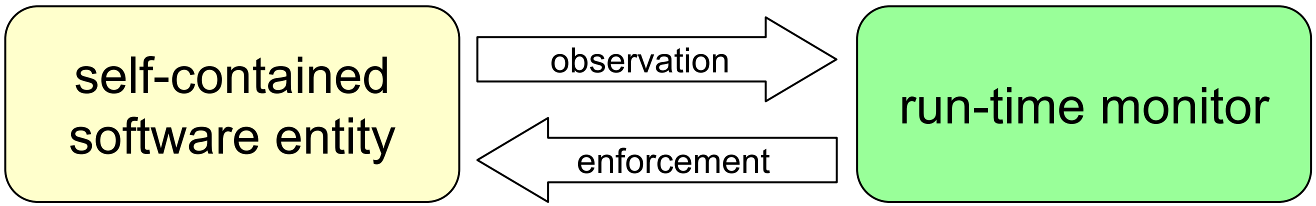
Provide infrastructures where ***security***, ***trustworthiness***, and ***privacy*** are governed in an ecosystem of service providers, hosts (such as Clouds), and consumers

Secure Services: Structure

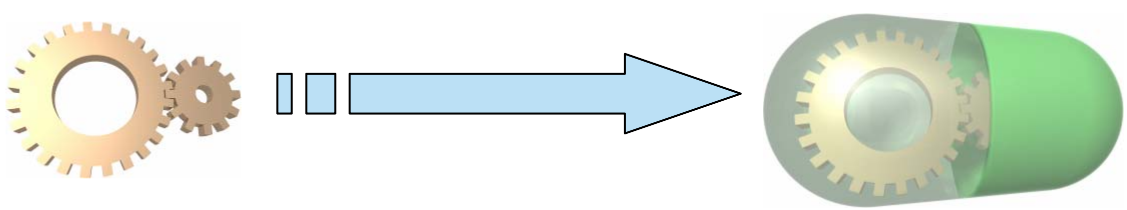


The Approach at a Glance

Controlling usage of data and resources at run-time



Encapsulation with a run-time monitor



unprotected service

encapsulated service

Implementing the encapsulation (collaboration with PP3):

aspect-oriented programming, inlining, monitoring in VM

Novel Concept: Service Automata

Generic in the security policy

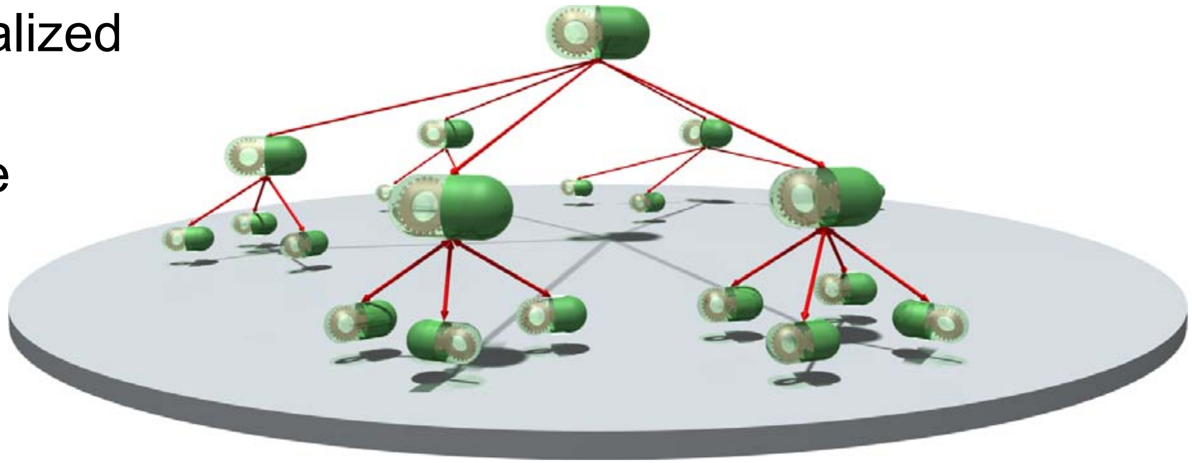
- enables flexible instantiation to security demands

Reliably respecting program and policy semantics

- provable because of formal specifications for both aspects

Suitable for distributed systems

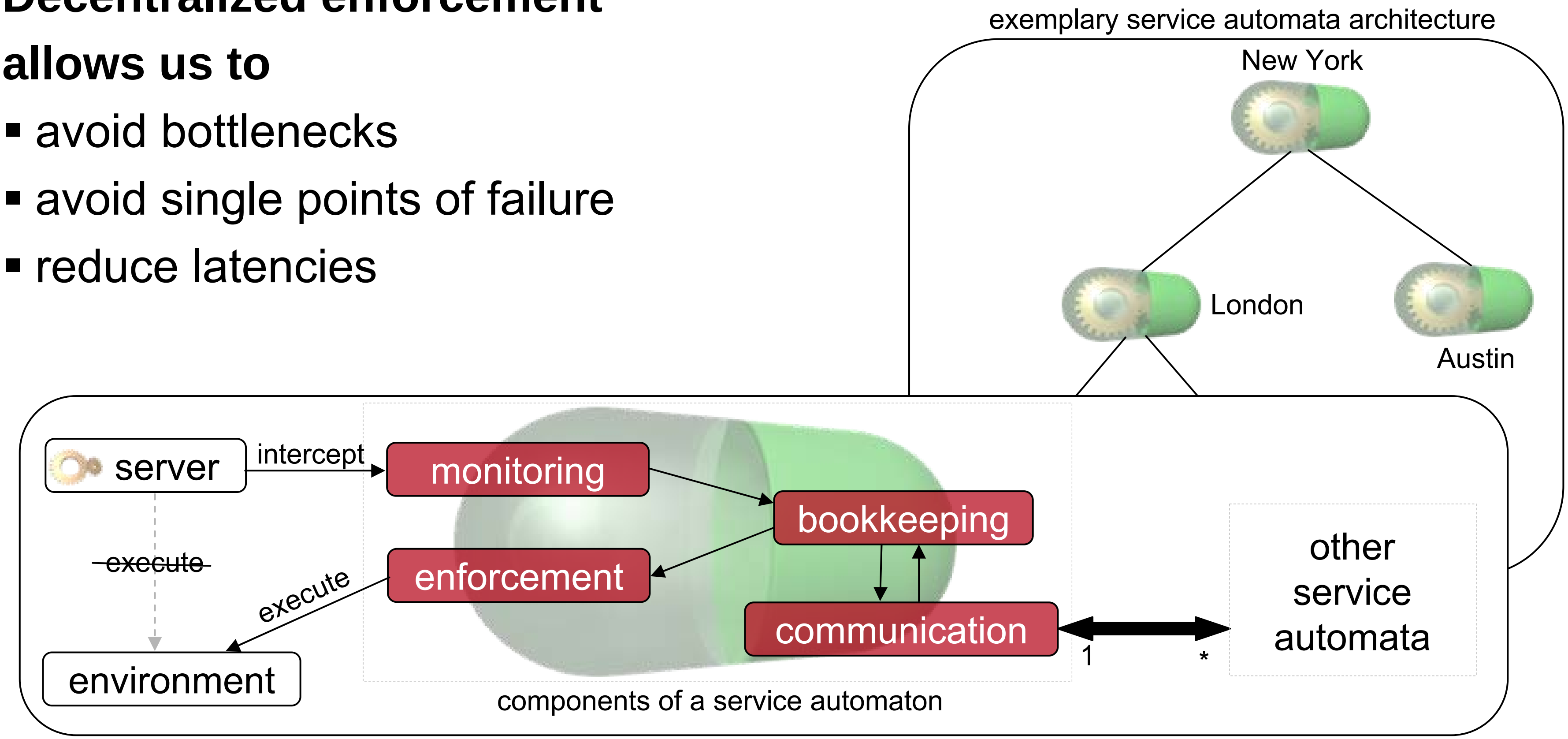
- due to efficient, decentralized enforcement
- communication structure independent from communication of the system



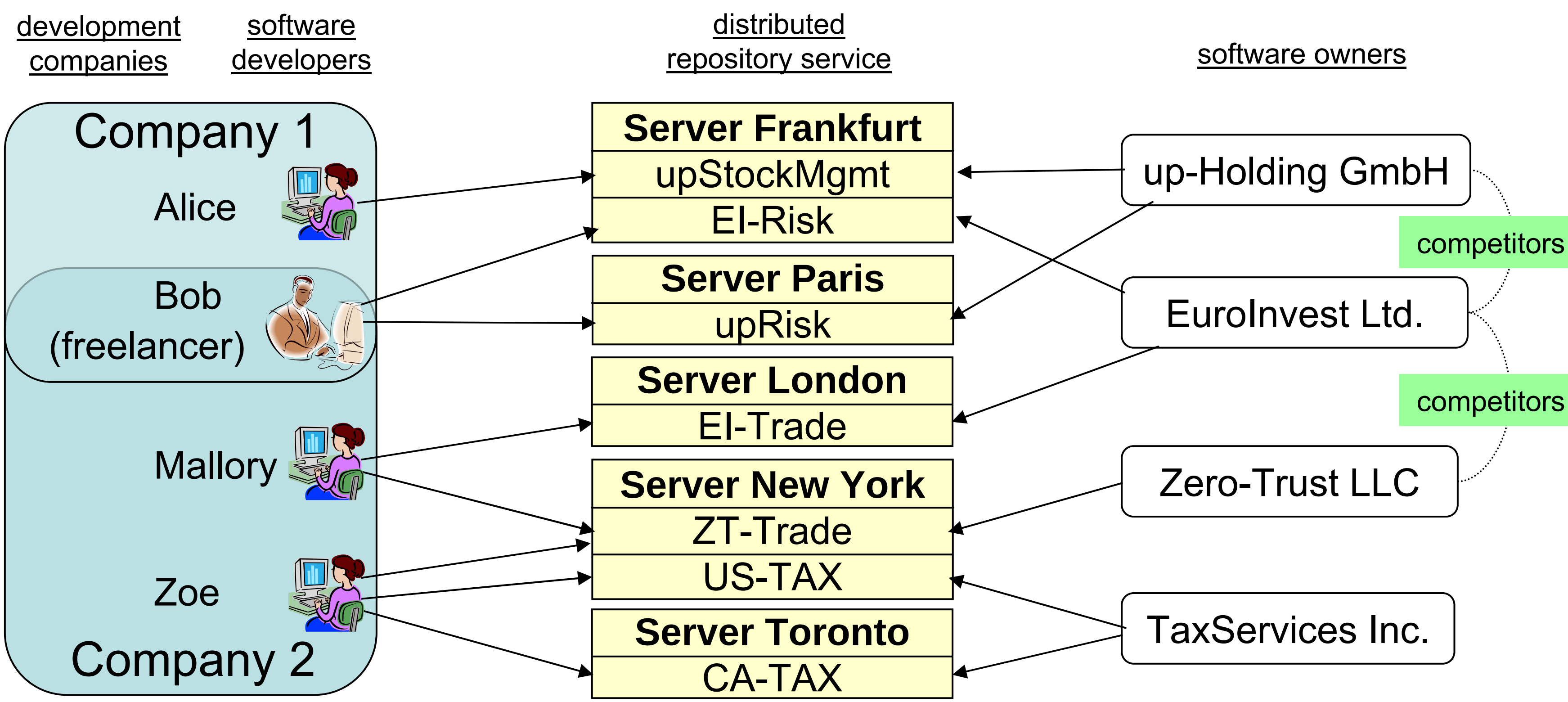
Service Automata in the Scenario

Decentralized enforcement allows us to

- avoid bottlenecks
- avoid single points of failure
- reduce latencies

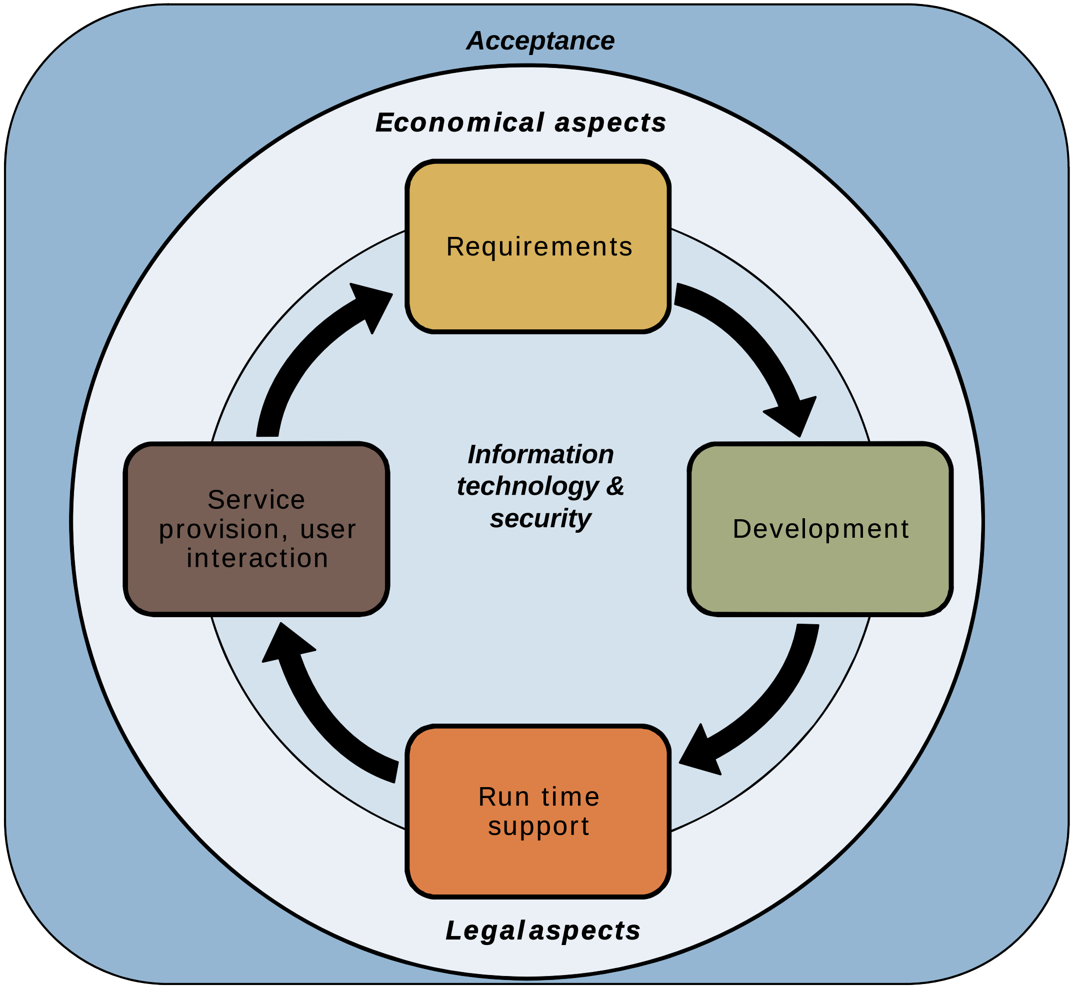


Example:
A Distributed Repository Service



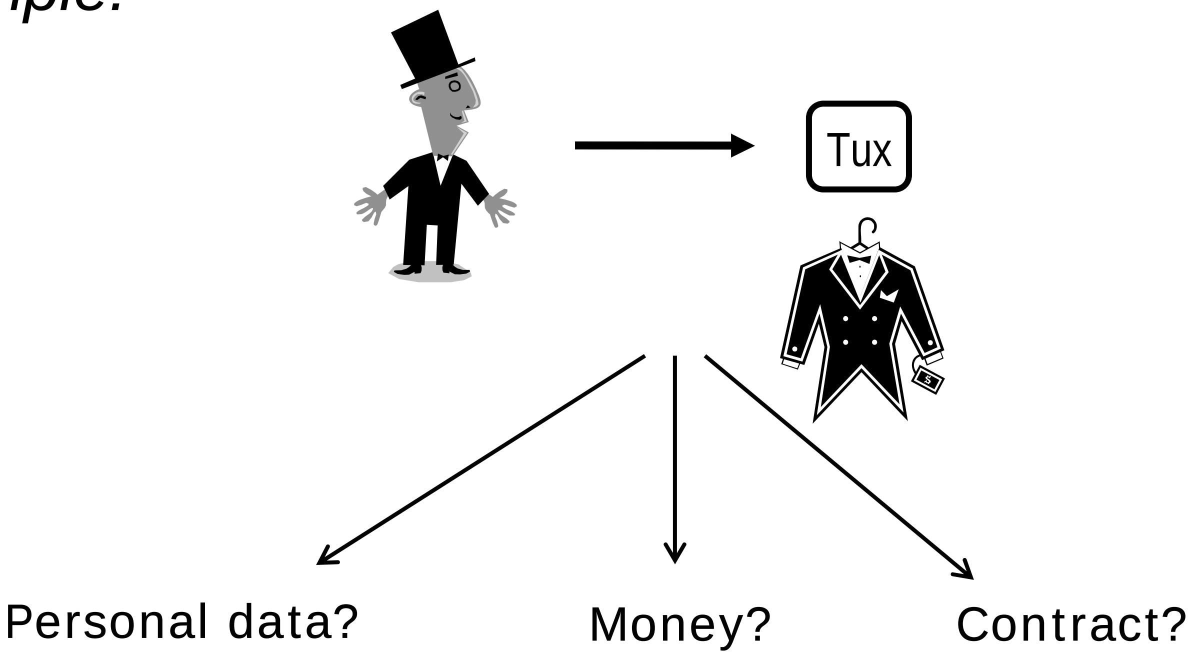
global security requirement: Chinese Wall (conflict of interest) could be enforced by centralized control in principle, but …

Secure Services: Challenges

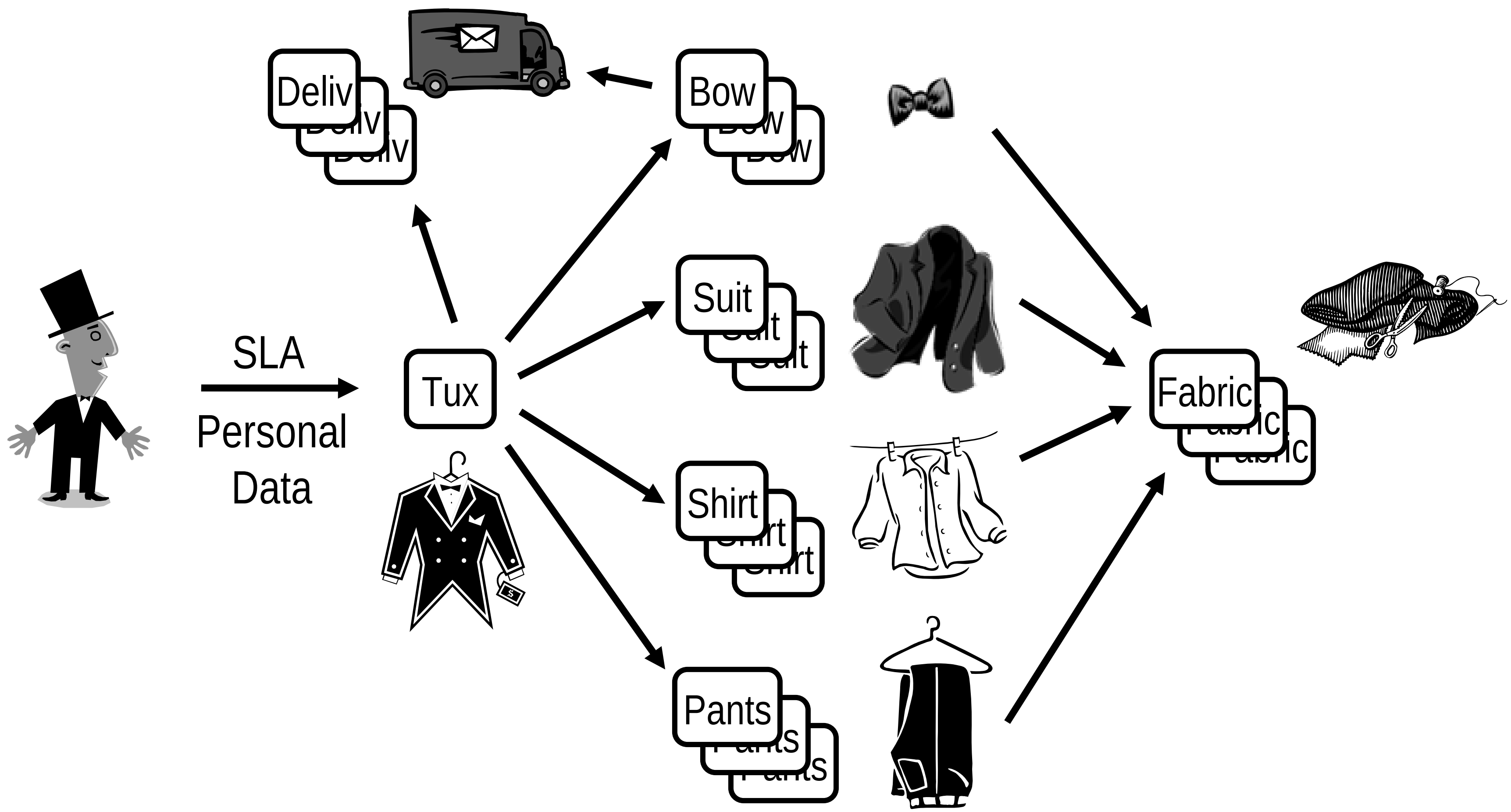


Motivation

- The **internet** is a **marketplace**:
  - Service providers offer services
  - Customers buy goods and information
  - *Example:*



What really happens:
Service composition & delegation



Secure Services
focuses on security aspects

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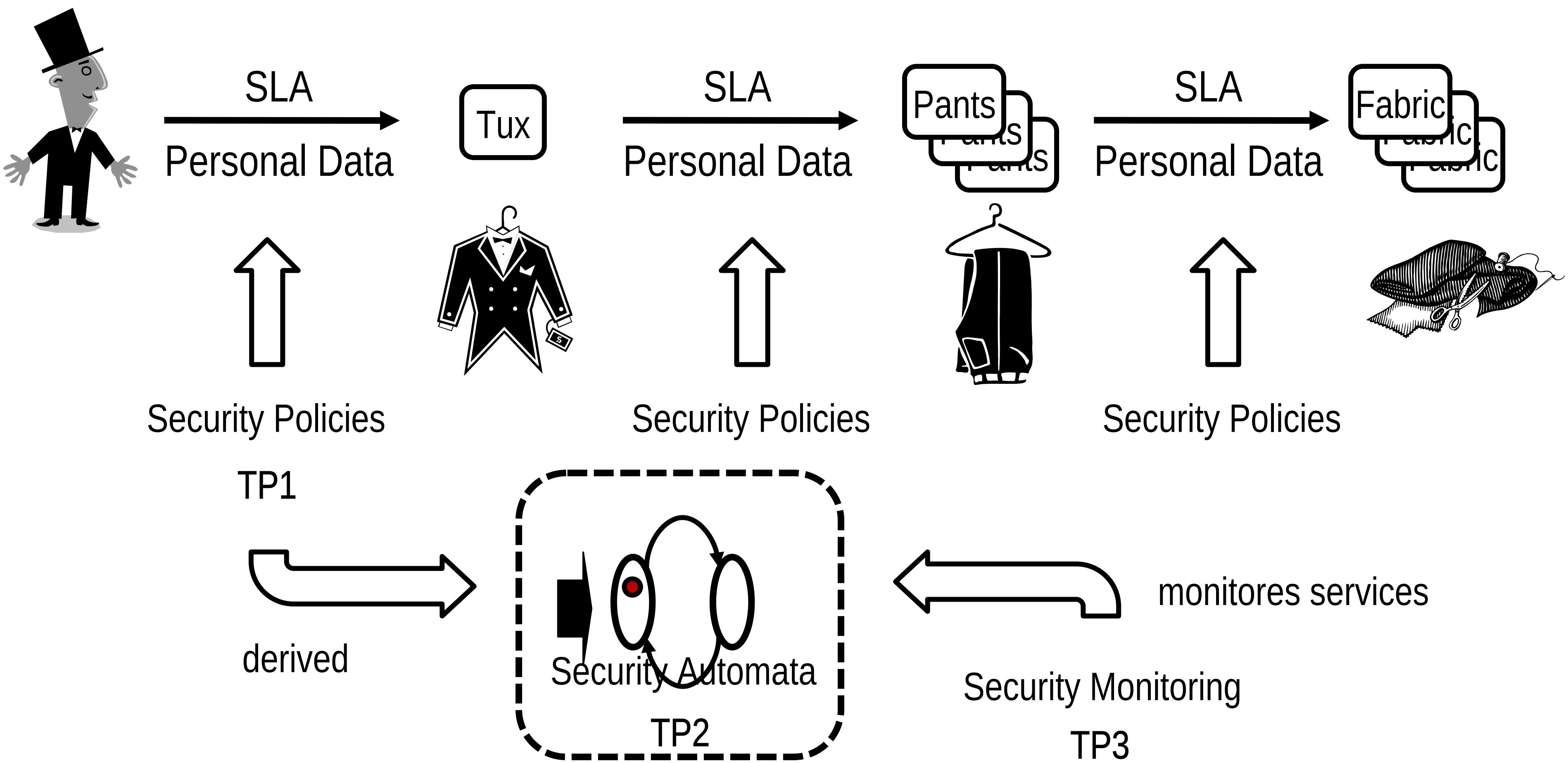

Secure Services
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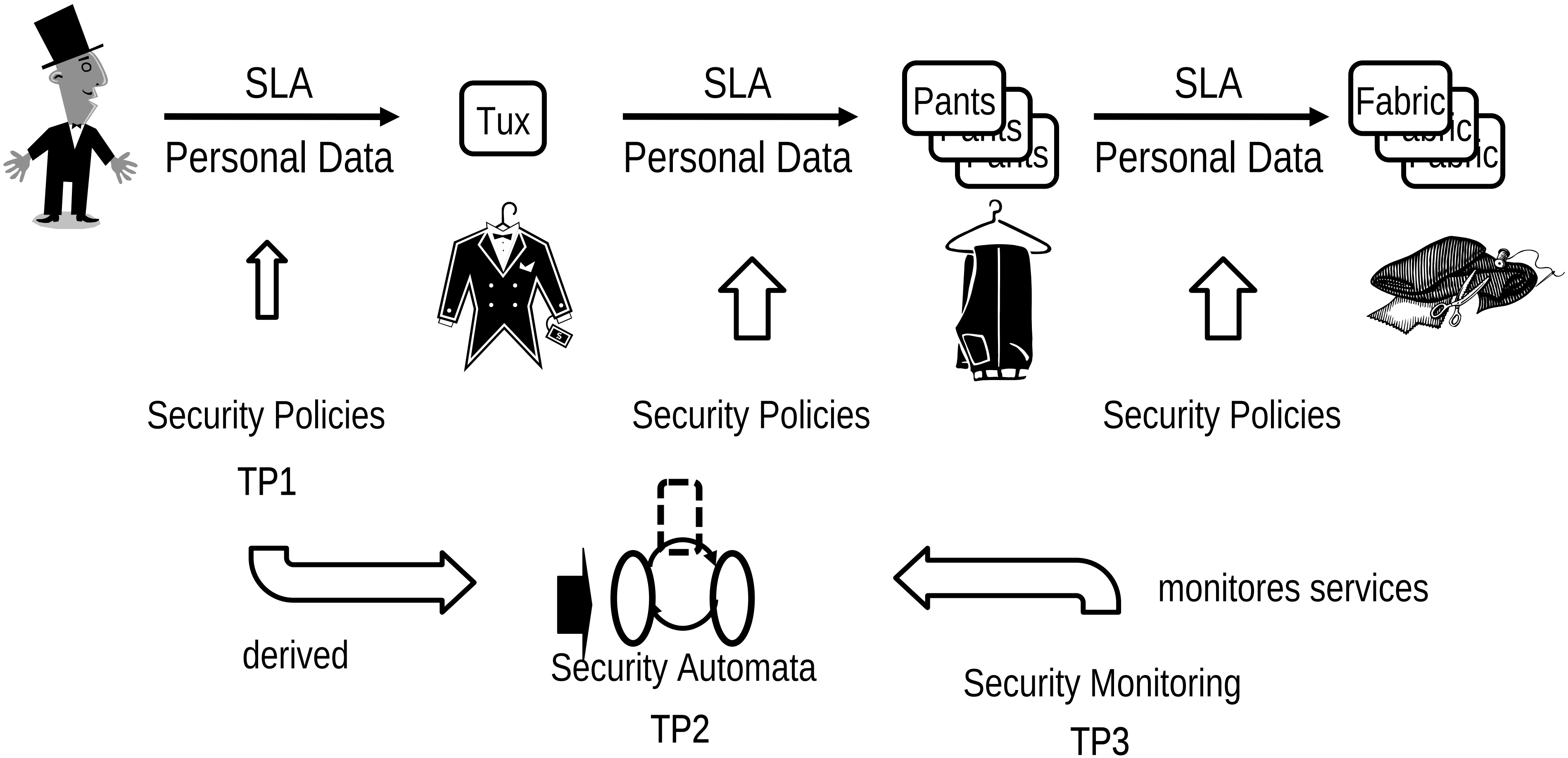
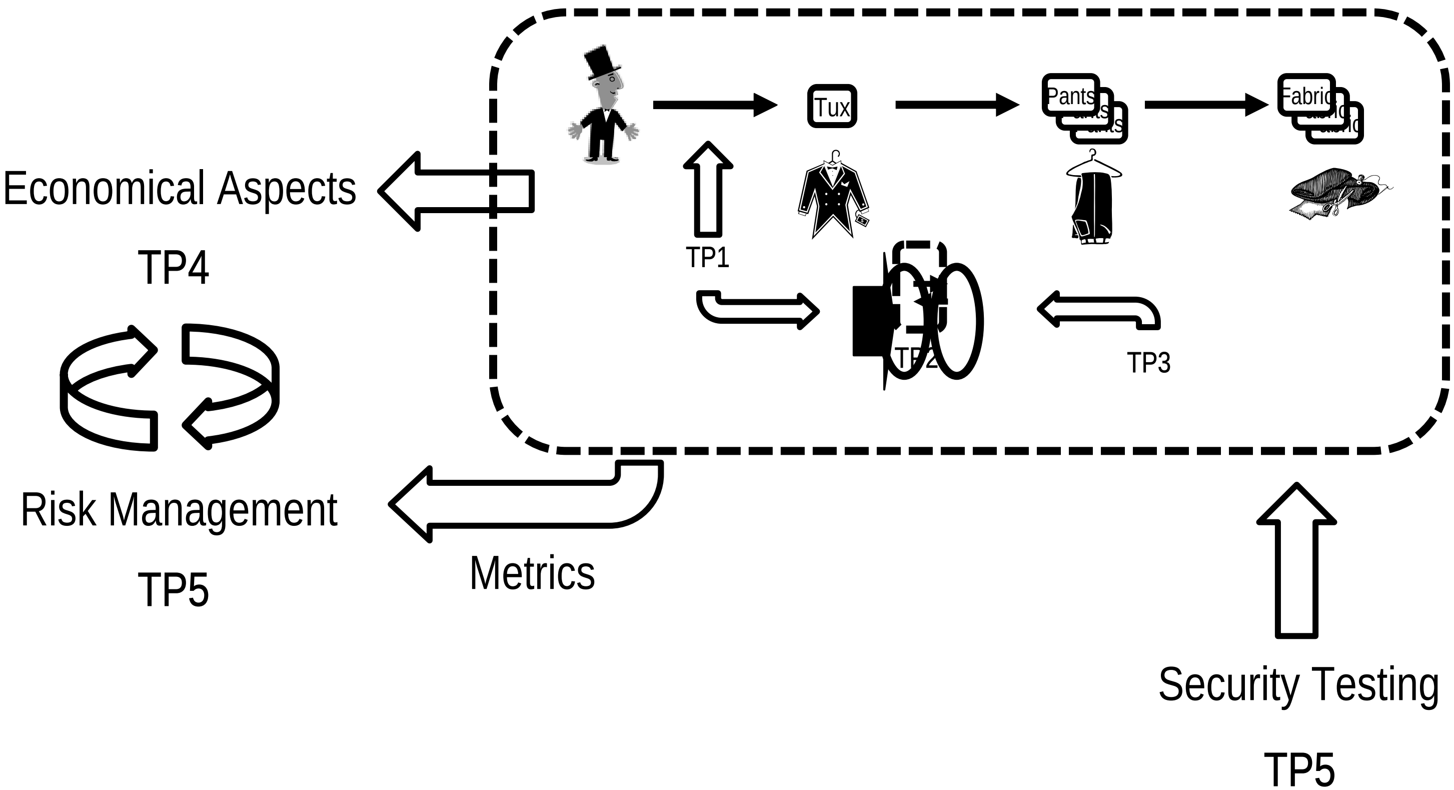
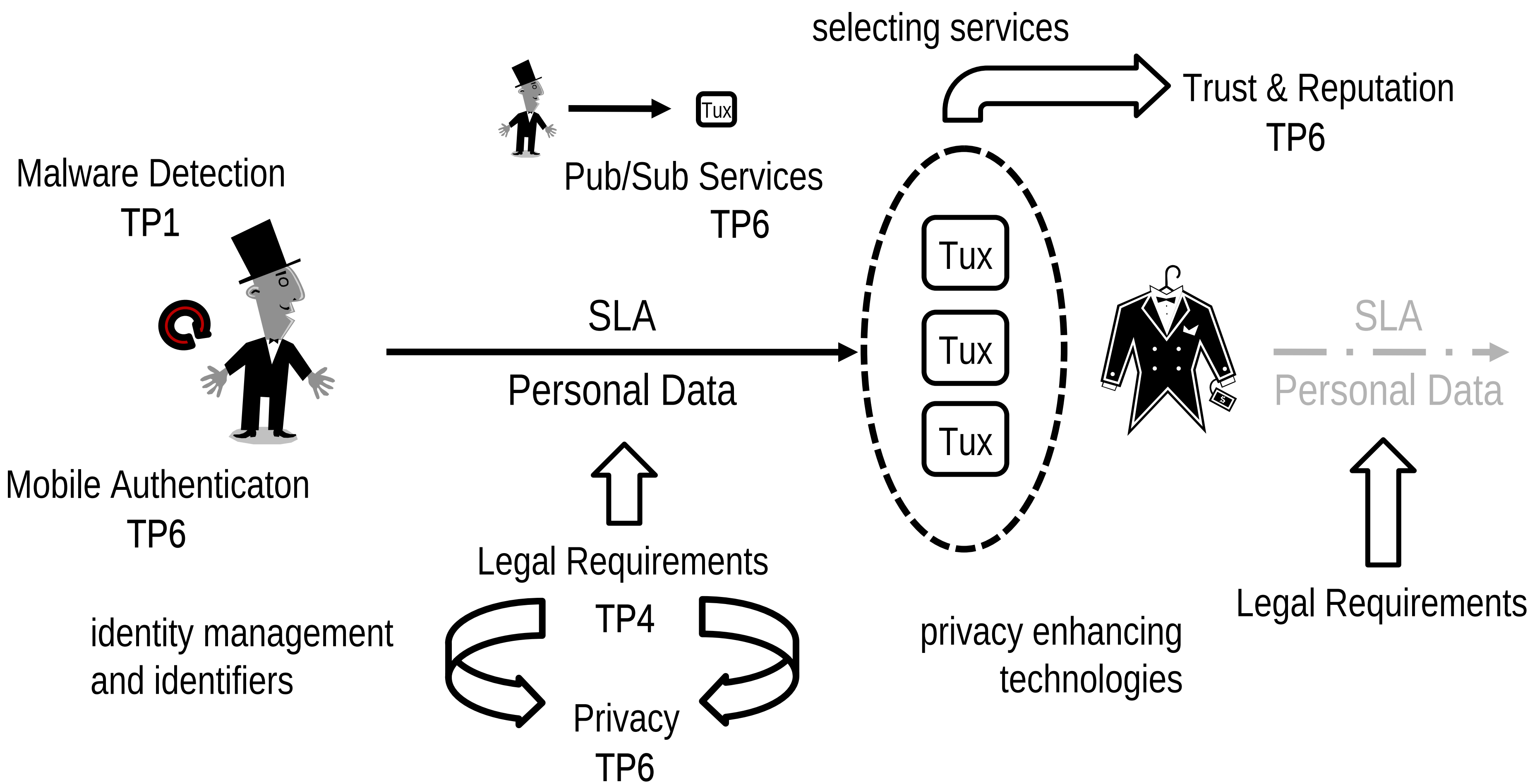


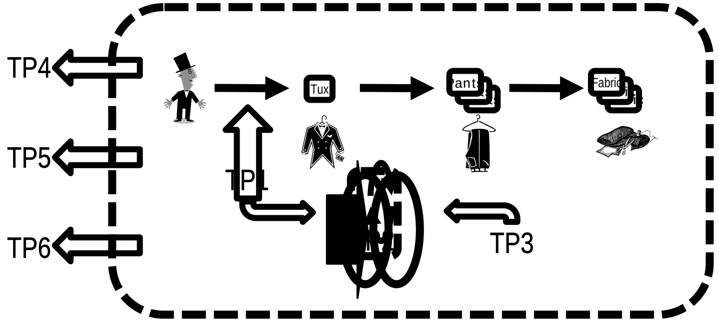
Secure Services focuses on security aspects



Secure Services
focuses on security aspects

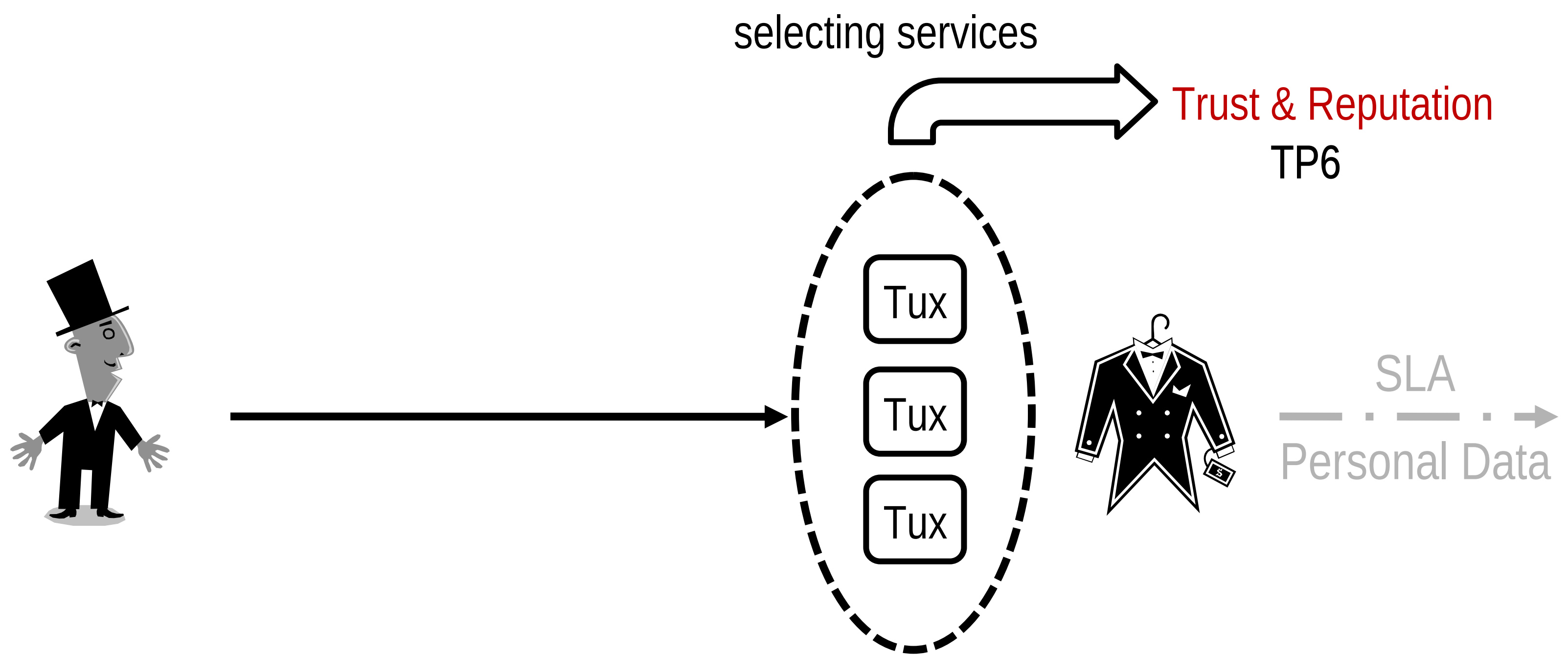


Secure Services at a Glance



- **TP 1: Security Policies**
- **TP 2: Security Automata**
- **TP 3: Security Monitoring**
- **TP 4: Legal and Economic Aspects of Secure Services**
- **TP 5: Risk Management, Security Indicators & Metrics**
- **TP 6: Secure Provision of Services**

Trust & Reputation



Goal: Selecting trustworthy service provider

➔ For better interactions

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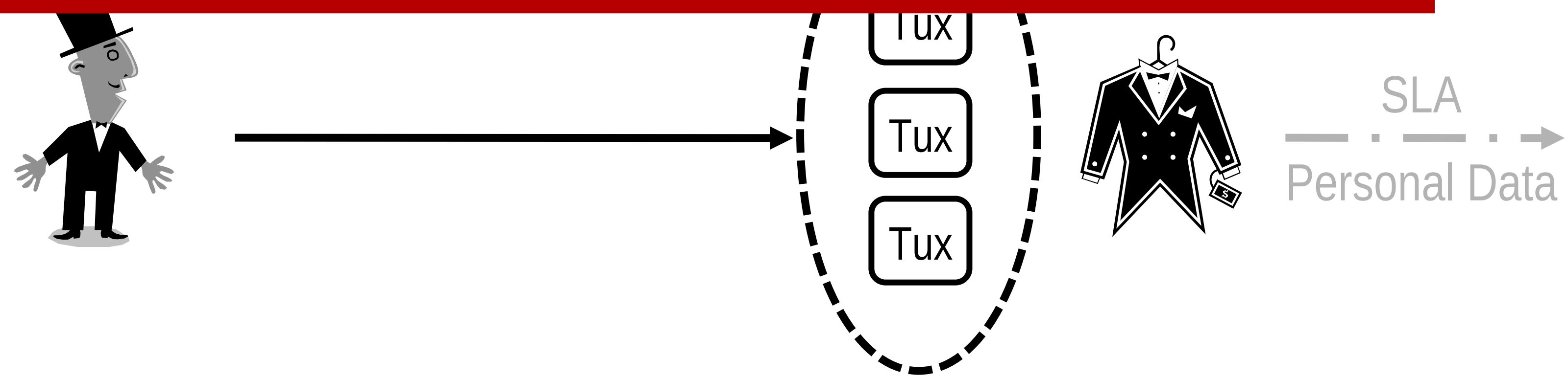
eBay sellers with established reputation could expect about **8% more revenue** than new sellers marketing the same goods.
[Resnick2006, Sun2009]



Goal: Selecting trustworthy service provider

➔ For better interactions

Research & Development within CASED @ Hochschule Darmstadt

[selected examples]



Real-time polymorphic malware detection

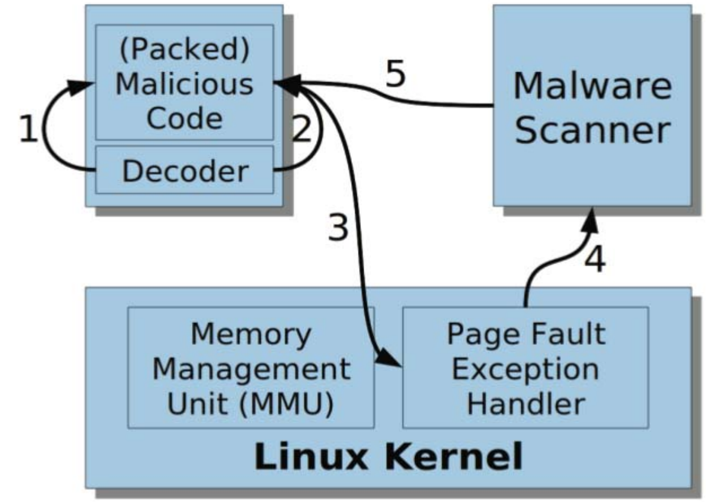
- **Christian Maaser – polymorphic malware detection**

Motivation

- Malware authors mask the same malicious code by packer or polymorphic self coding & encrytion
- Current Anti-Malware-Software cannot detect and identify the masked malware

Idea and goal

- Virus scanners should by able to detect and identify in real-time the unmasked Malware-Code



Fingerprint Sample Quality

- **Martin Olsen - predicting Biometric Performance**

Motivation

- Border control requires good fingerprint quality
- Good fingerprint sample quality results in good recognition achievements

Idea and Goals

- New Implementation of NFIQ2
- Tiny Implementation for mobile Systems

Approach

- Research of characteristics, which correlate image quality and recognition achievement

Walk characteristic as biometrical authentication (1)

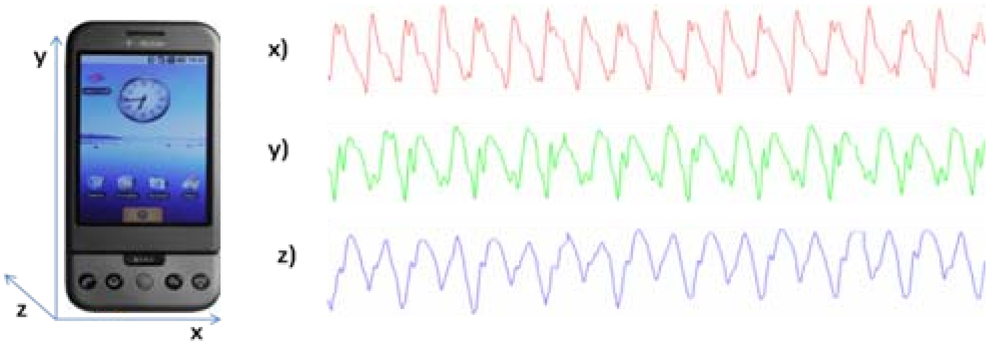
- **Claudia Nickel - the way you walk**

Motivation

- Data in mobile phones are not protected sufficiently
- Normal case: No PIN needed after idle mode

Idea and Goal

- Concurrent biometrical authentication can substitute PIN

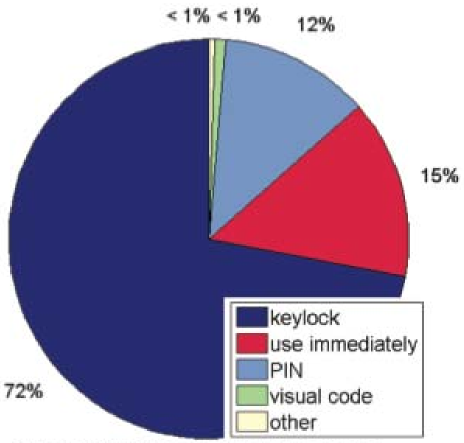


Walk characteristic as biometrical authentication (2)

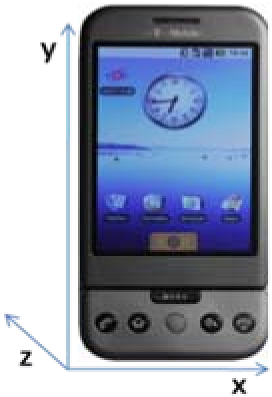
- **Claudia Nickel - the way you walk**

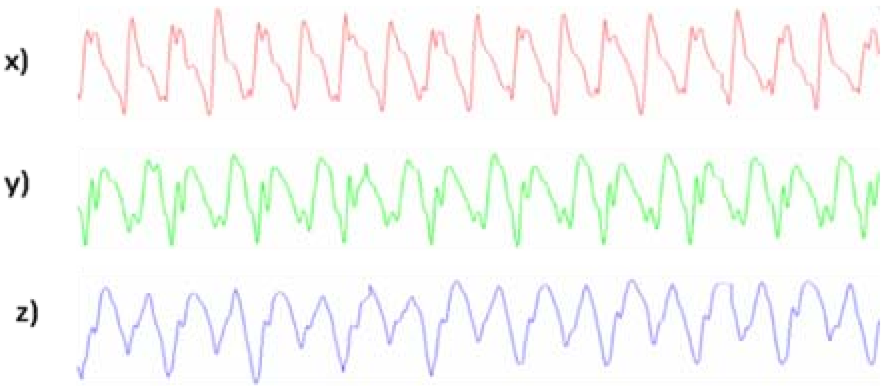
Approach

- Capturing and logging of the human walk characteristics by integrated semi-conductor acceleration sensors, sensitive to motion



Survey of 548 users of mobile phones





Intrusion Prevention System @ host

- **Mark Seeger - preventing malicious attacks**

Motivation

- Host-based intrusion detection system (IDS) as basic security of Host OS
- Malware at host can manipulate IDS results

Idea and Goal

- Outsourcing of the IDS monitoring towards the GPU and observing access to CPU memory

Approach

- Independent execution at GPU Kernels

Motivation
– the "What, Why, and How?"

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Current Host - intrusion detection system (IDS)

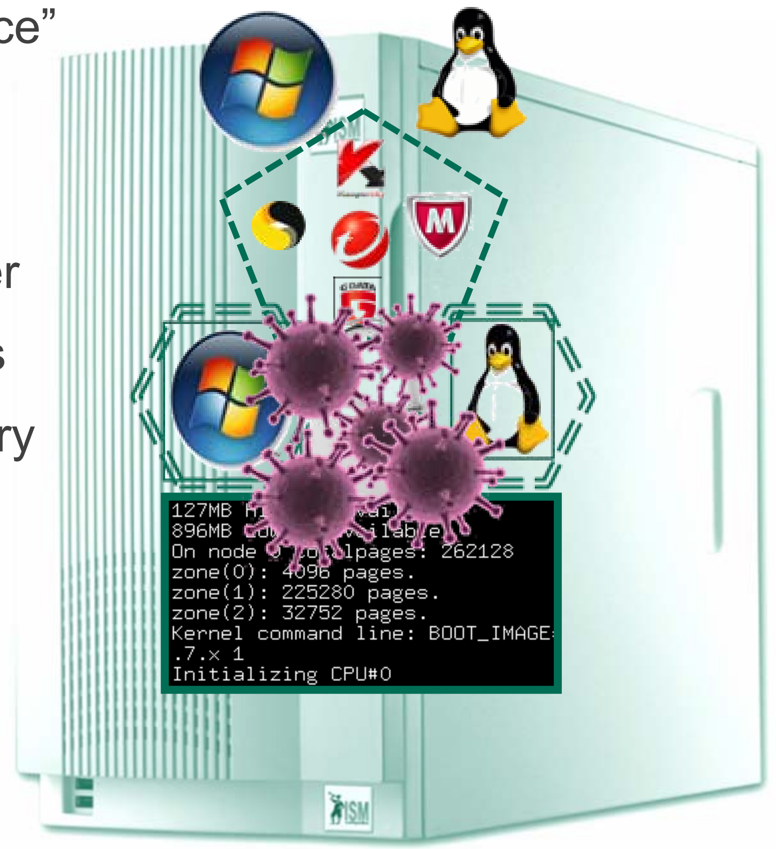
- Installed on Host
- Running in parallel to other software
- Executed by CPU

Motivation
– the “What, Why, and How?”

CASED

Issues

- IDS “just another service”
- Relies on OS security
- Relies on CPU
- Relies on OS scheduler
- Consumes CPU cycles
- Consumes host memory
- …



User

IDS

Driver/KM

OS

Motivation
– the “What, Why, and How?”

Infected

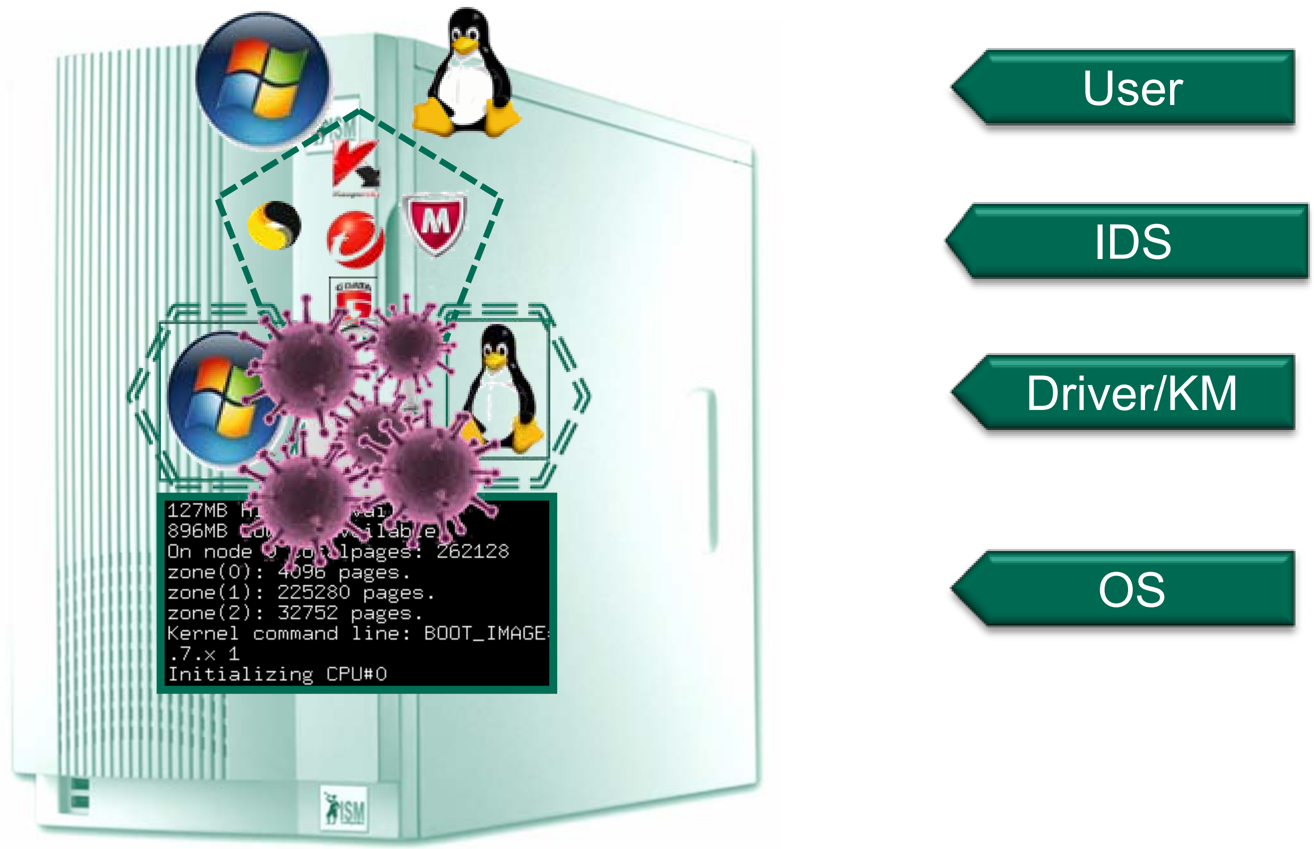
- IDS results falsified
- Backdoors
- Botnet

What can we do?

- Clean
- Reinstall

Can we do better?

- Off-host host-IDS



Motivation
– the “What, Why, and How?”

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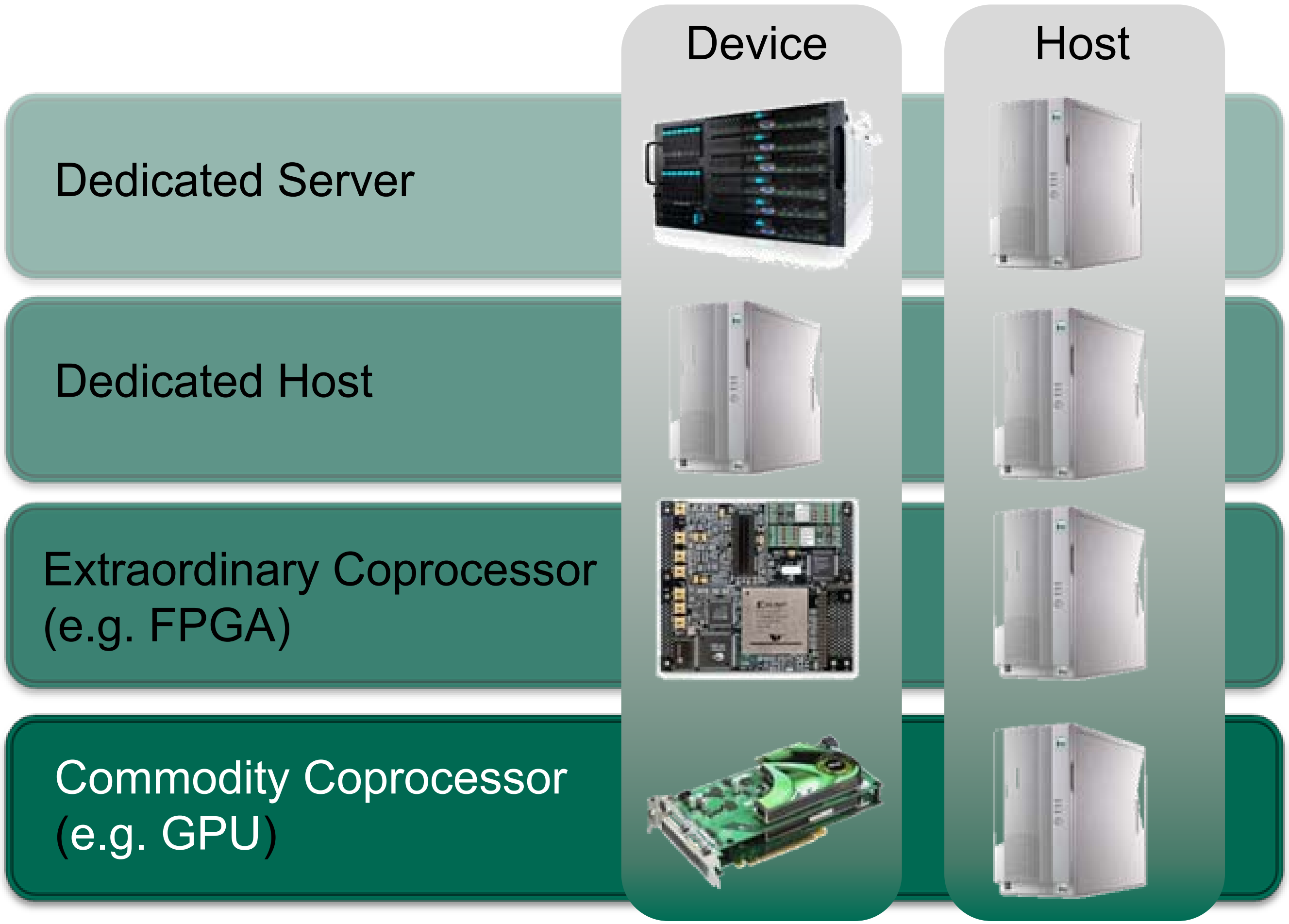

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Motivation
– the "What, Why, and How?"

Device | Host

Commodity Coprocessor
(e.g. GPU)

Usage of a **GPU** for Host intrusion detection

- Benefits: Tightly coupled, asymmetric, concurrent
  - Tightly coupled: Shared memory (NUMA)
  - Asymmetric: A processor other than the host's CPU
  - Concurrent: Autonomously running next to the host's CPU

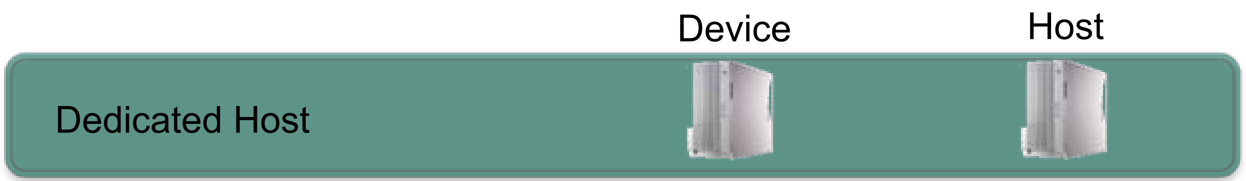
Motivation – the "What, Why, and How?"

- **Coprocessors**
  - Special–purpose Processors, dedicated to perform certain operations
  - Capable of few operations on the one hand, very fast on the other

- **Coprocessors are ubiquitous**
  - Network intrusion detection: Well-known (FPGA, GPU, etc.)
  - Host intrusion detection: Not used so far

- **Host intrusion detection by coprocessor**
  - Faster: Dedicated processor (more CPU time for normal duty)
  - More secure: No host service or host installation

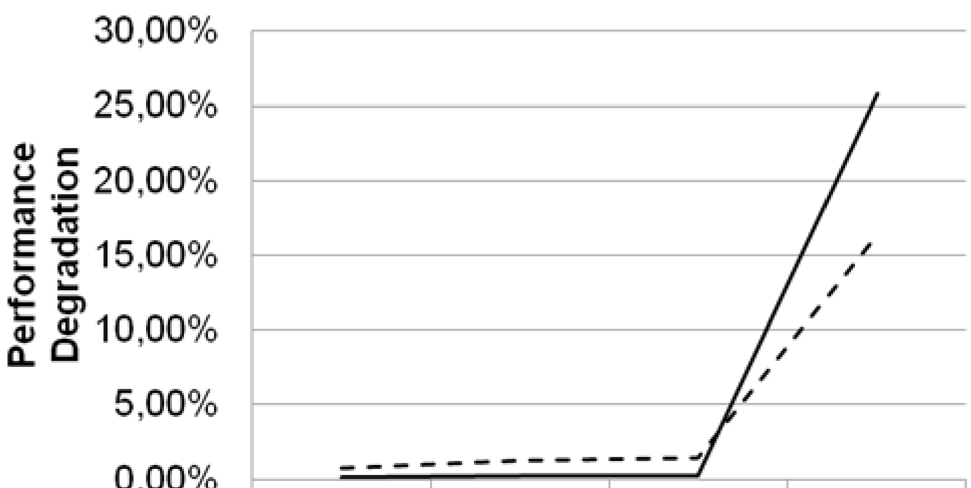
First Results: Performance Degradation



Testing environment:
One host was used as a **coprocessor** for the other

Performance degradation according to…

- …the size of the **observed data structure**.



	8	16	32	64
- - - 1P	0,75%	1,27%	1,46%	16,37%
—— 2P	0,16%	0,22%	0,20%	25,84%

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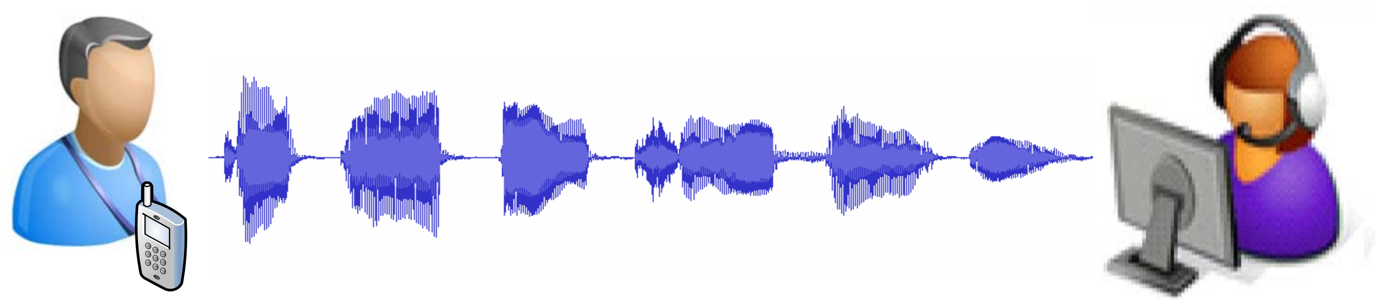
[# Processes]

Secure Telephony in NGN & IMS as well as in PSTN & PLMN



- Andreas Plies – Call authentication
- Torsten Wiens – Call integrity

VoIP Usage Worldwide

CASED

- **Number of residential, small- or home office VoIP subscribers grew 24 % in 2009 to 132 million worldwide**
  [Infonetics Research, 04/2010]
- **Total number of mobile VoIP users will be reach 288 million by end of 2013**
  [In-Stat, 03/2010]
- **10.3 million VoIP users in Germany 2010**
  [BITKOM, 04/2010]

Conversational Partner Recognition

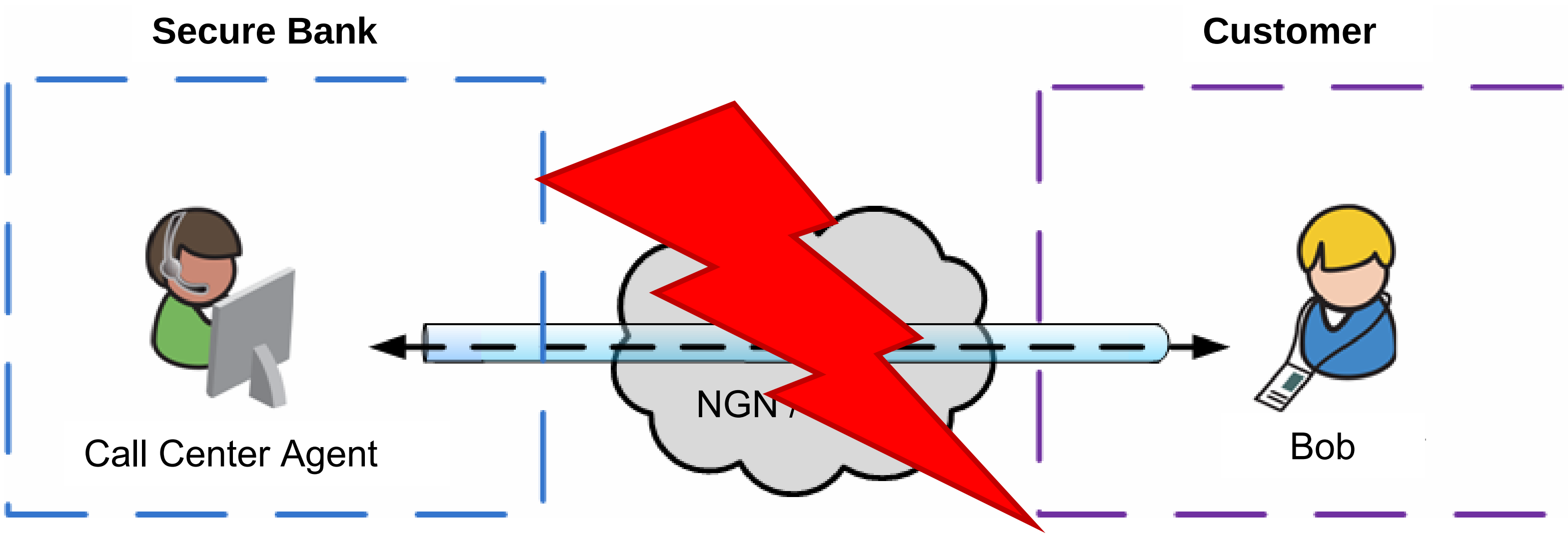
„It‘s me, Obama.“

Barack Obama

„Are you kidding me?“

Ileana Ros-Lehtinen

How to identify your conversational partner?



- Possible approaches for authentication ?
  - Via voice?
  - Via phone number?
  - Combination of customer number and password?
  - Cryptographic hardware solutions?

So how U-CAN check who is calling?

- **nPA-VoIPS**
  - Secure VoIP Telephony
  - Confidential Communication
  - Authentication of communication partner
  - Legally compliant archiving with qualified signature

→ for IMS & NGN

- **Universal Call Authentication (U-CAN)**
  - Secure Telephony in PSTN & PLMN
  - Authentication of communication partner

→ for PSTN & PLMN

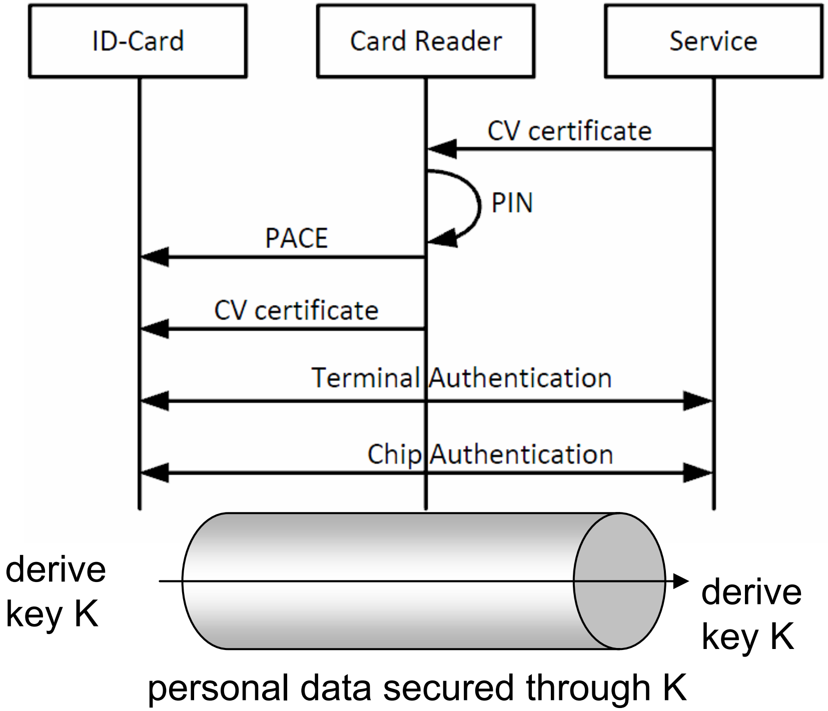
German Identity Card

- Rollout November 1st, 2010
- Identity card (IC) in credit card size
- Contactless RFID Chip(ISO 14443)
- Sovereign usage like european passport
- Additional functionalities:
  - Qualified electronic signature like specified in German „Signaturgesetz“ (optional)
  - **Electronic Identiy (eID)** for E-Business and E-Government Services

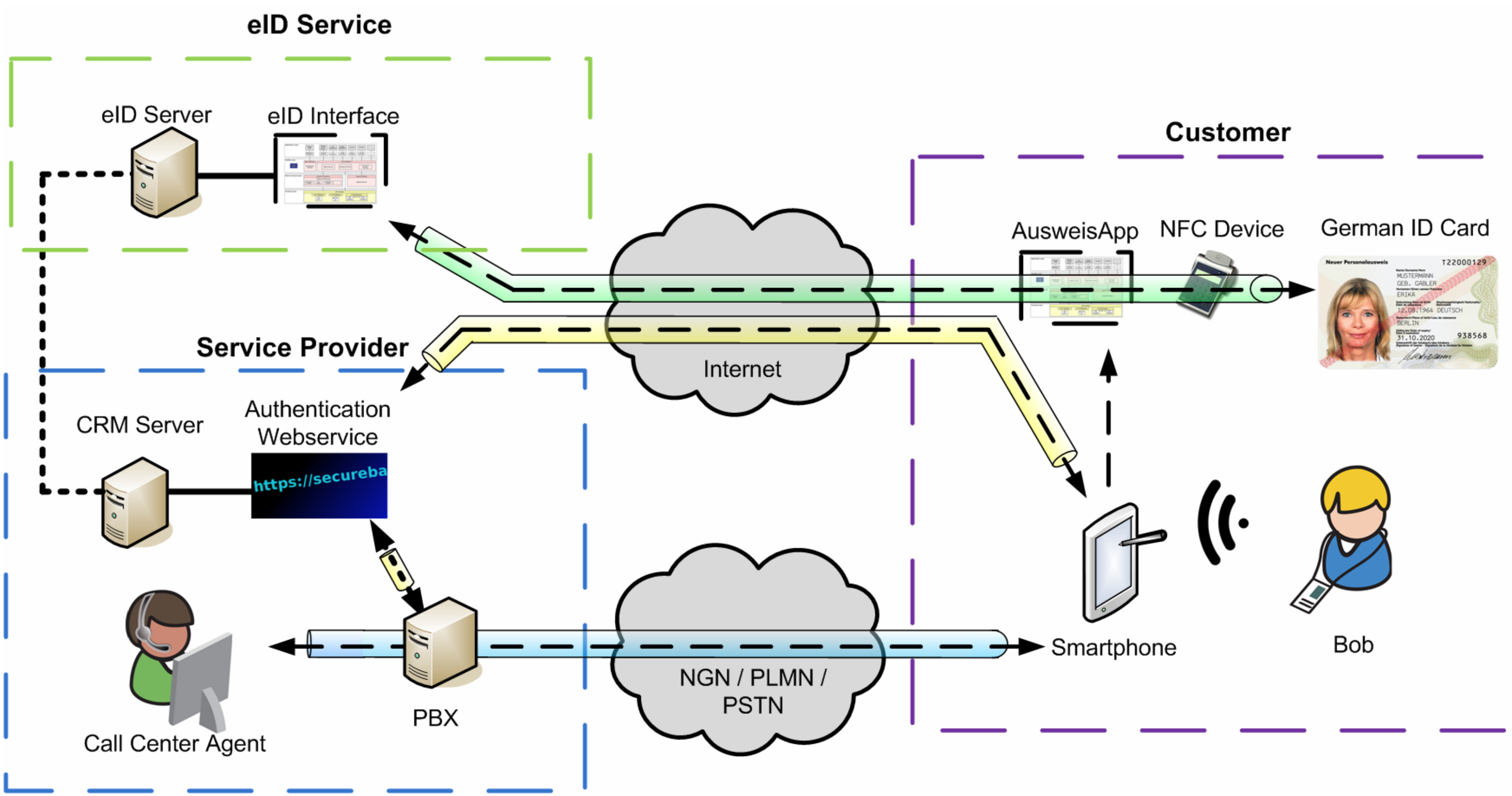
  → 2-Factor-Authentication

Electronic ID Authentication

- **Service provider owns a Card Verifyable (CV) certificate**
  - Issued by federal office to trustworthy service provider
  - Contains information about the identity and access rights of the service provider
- **PIN**
  - Allows Identity card (IC) holder to grant access
- **PACE**
  - Password Authenticated Connection Establishment
- **Terminal Authentication**
  - Authentication of service towards IC
  - Proof of provider‘s identity and access rights
- **Chip Authentication**
  - Authentication of IC towards service
  - Proof of Authenticity



eID Authentication for telephone calls with ID Card



People: Secure Services

Thank you for your attention

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