Secure Systems Groups

Demo Day 2015

N. Asokan, Tuomas Aura, Valtteri Niemi

Aalto University

UNIVERSITY OF HELSINKI

“State of the Union”

Who are we?

- Aalto University
  - 2 professors
  - 1 (+1) postdocs
  - 5 full-time & several industrial PhD students
  - Several MSc thesis students
  - Several interns
- University of Helsinki
  - 1 full-time + 1 part-time professor
  - 1 postdoc
  - 1 MSc thesis student

How are we funded?

- Aalto
  - 2 Academy of Finland projects
  - Intel CRI for Secure Computing (ICRI-SC) at Aalto
  - Basic funding from Aalto
  - Research collaboration with Huawei
  - MATINE (Ministry of Defense) project
  - IoT SHOK
  - New: Cyber Trust SHOK
- University of Helsinki
  - Basic funding from UH
  - (close collaboration with ICRI-SC at UH at the NODEs unit)

What do we work on?

- (Mobile) Platform Security
- Contextual Security
- Cloud Security

- 5G Security

- Security Protocol Engineering
- Network Security
- Security for Ubiquitous Computing

What do we work on?

Security

Usability

Deployability

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Where are we publishing?

- Proc. IEEE, ACM CCS, **ACM UbiComp**, PMC journal
- ACM WiSec, **ACM ASIACCS**, Financial Crypto
- NordSec, NordiCHI

- Best Paper Awards

Self evaluation:
Good but room
to improve

What do we teach?

- Information Security courses
  - Bachelor level course on Information Security
  - MSc level courses on network security, mobile system security
  - Seminar and laboratory courses
  - Shared courses between Aalto and UH
- Courses taught by industry experts
  - “Malware course” (F-Secure), Software Security (Vähä-Sipilä)

Who did we train?

- Aalto: ~12 MSc theses, ~10 BSc theses
  - Olli Jarva: **won** best infosec thesis prize (Finnish Information Security Association); **runner-up** best CS thesis (Finnish Computer Science Association)
- UH: 3 MSc theses
- Invited sessions at summer/winter schools
  - 2014: Padova Summer School, Technion TCE Summer School, Estonian Summer School in Computer Science

Industry Collaboration

- Industry-funded collaborative projects
  - Intel, Huawei
- Publicly-funded collaborative projects
  - Electrobit, Ericsson, F-Secure, Ministry of Defense, Nokia, nSense, Huawei, Trustonic
- Other collaboration with industry sector
  - Trustonic, SSH
- Collaboration with state sector
  - Väestörekisterikeskus (eID), Ministry of Justice (Internet elections), FICORA (cryptography)

Where do we go next?

2014
DemoDay

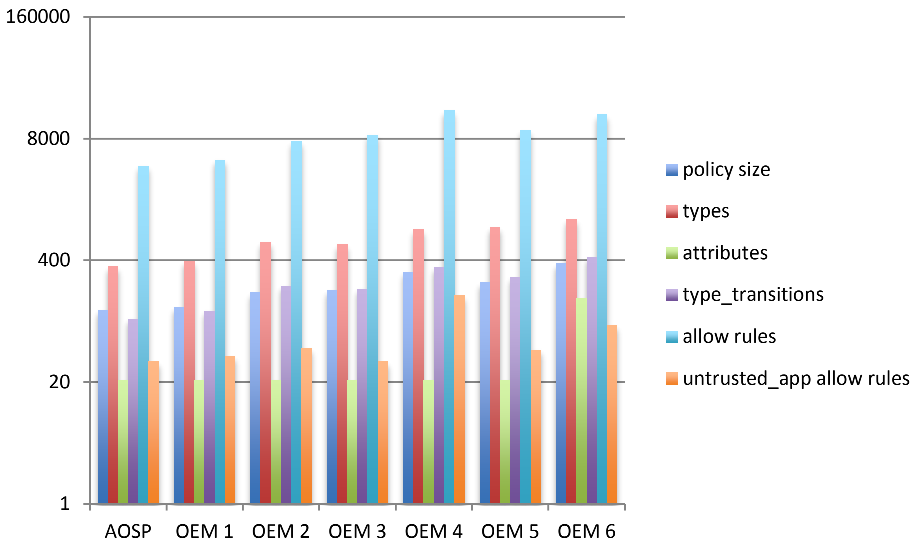
- Secure Systems will continue at UH
  - Hien Truong continues as postdoc
  - I will be actively involved
  - UH will recruit a new professor for information security
- My wishlist
  - Aalto and UH Secure Systems groups work together ✓
  - Courses in both universities open to both universities ✓
  - Supervision across university boundaries ✓
  - Industry collaboration to attract the best students

Demo Teasers

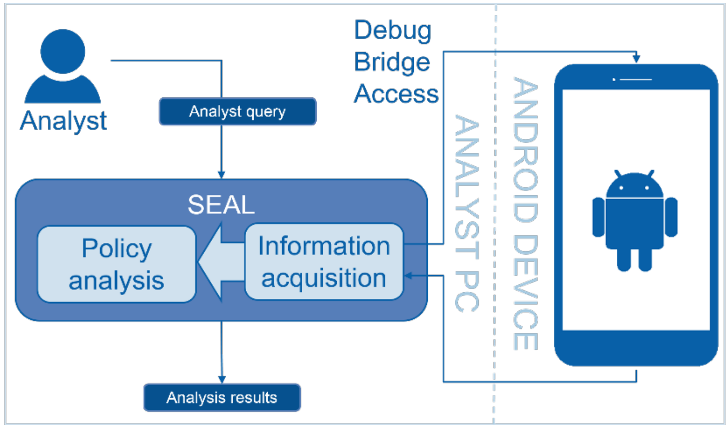
SEAndroid Policy Analytics

How to enable OEMs to design better SEAndroid policies?

SEAndroid is now mandatory



SEAL: A suite of tools for SEAndroid policy Analytics



Manual analysis: examples of ineffective and potentially unsafe rules added by OEMs

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TRUSTONIC

intel

Collaborative Research Institute for Secure Computing

Filippo Bonazzi

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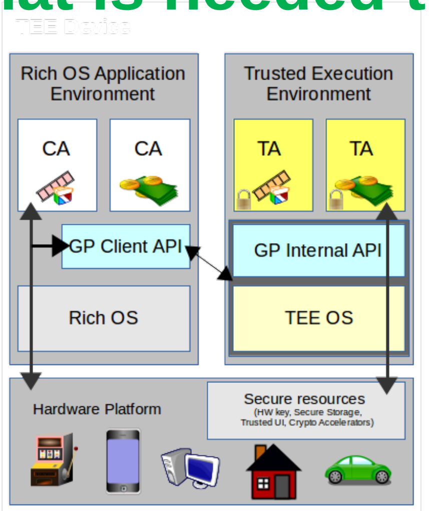
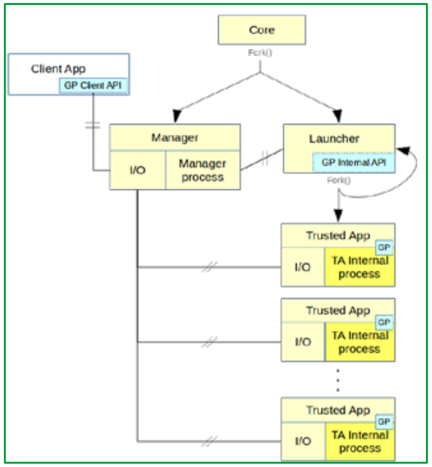
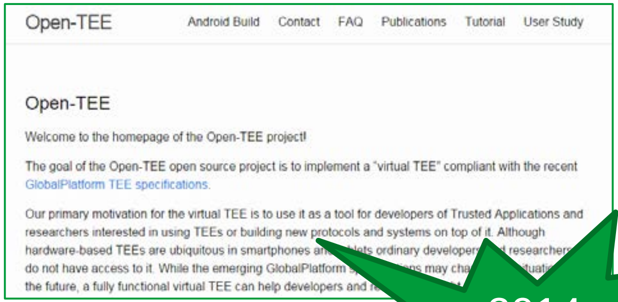
https://se-sy.org/projects/seal

Open Virtual TEE

What is needed to enable app developers to use trusted h/w?


TEE Device
Rich OS Application Environment
Trusted Execution Environment
CA
CA
TA
TA
GP Client API
GP Internal API
Rich OS
TEE OS
Hardware Platform
Secure resources
(HW key, Secure Storage, Trusted UI, Crypto Accelerators)





Open-TEE

Welcome to the homepage of the Open-TEE project!

The goal of the Open-TEE open source project is to implement a "virtual TEE" compliant with the recent GlobalPlatform TEE specifications.

Our primary motivation for the virtual TEE is to use it as a tool for developers of Trusted Applications and researchers interested in using TEEs or building new protocols and systems on top of it. Although hardware-based TEEs are ubiquitous in smartphones an blets ordinary developers d researchers do not have access to it. While the emerging GlobalPlatform s ns may cha ituatio the future, a fully functional virtual TEE can help developers and re

http://open-tee.gi

2014
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- Open-TEE is a GlobalPlatform (GP)-compliant virtual trusted execution environment (TEE)
  - Intended as a developer aid; can also be a fall-back TEE
- Open-TEE session for GP App Developers Workshop

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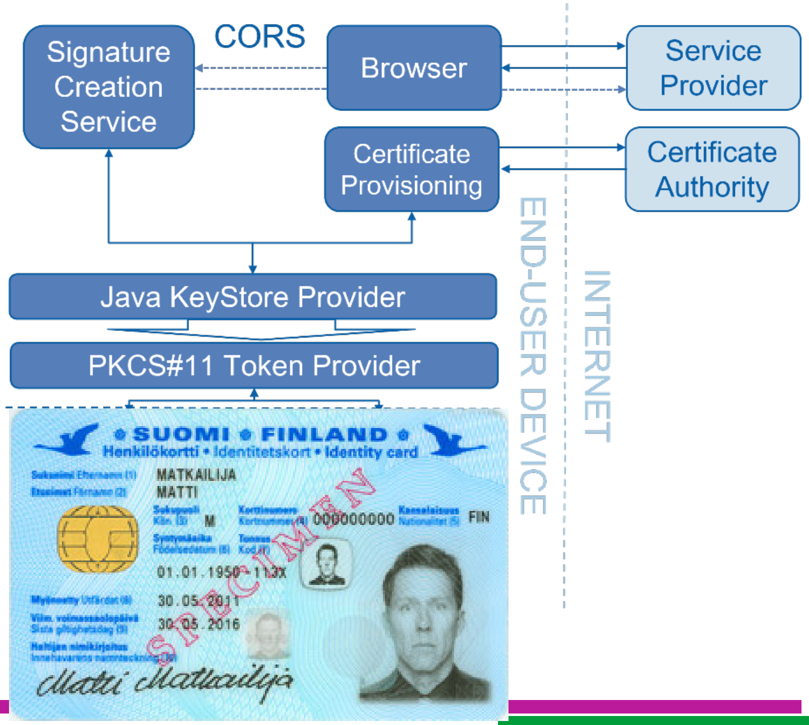
Deploying TEE-based Authentication

What do service providers need in order to improve security/privacy in their services using TEEs?

- Support entire user base:
  - Devices with different types of TEEs, no TEEs
- Showcase: eID scheme specified by VRK



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Väestörekisterikeskus
Befolkningsregistercentralen

intel Collaborative Research Institute for Secure Computing

HUAWEI

Thomas Nyman

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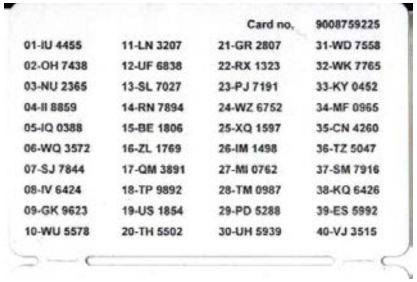
https://se-sy.org/projects/eid/

Person authentication in Finland

- Transaction Authentication Number
  - One time passcode cards
  - Widely used
  - High logistics costs, controlled by banks



		Card no.	9008759225
01-IU 4455	11-LN 3207	21-GR 2807	31-WD 7558
02-OH 7438	12-UF 6838	22-RX 1323	32-WK 7765
03-NU 2365	13-SL 7027	23-PJ 7191	33-KY 0452
04-II 8859	14-RN 7894	24-WZ 6752	34-MF 0965
05-IQ 0388	15-BE 1806	25-XQ 1597	35-CN 4260
06-WQ 3572	16-ZL 1769	26-IM 1498	36-TZ 5047
07-SJ 7844	17-QM 3891	27-MI 0762	37-SM 7916
08-IV 6424	18-TP 9892	28-TM 0987	38-KQ 6426
09-GK 9623	19-US 1854	29-PD 5288	39-ES 5992
10-WU 5578	20-TH 5502	30-UH 5939	40-VJ 3515

- Citizen PKI (Kansalaisvarmenne)
  - Deployed for over a decade
  - Expensive, requires a reader

SUOMI • FINLAND
Henkilökortti • Identitetskort • Identity card

Sukunimi Efternamn (1) MATKAILIJA
Etunimet Förnamn (2) MATTI
Sukupuoli Kön (3) M
Korttinumero Kortnummer (4) 000000000
Kansalaisuus Nationalitet (5) FIN
Syntymäaika Födelsedatum (6) Tunnus Kod (7)
01.01.1950 - 113X
Myönnetty Utfärdat (8) 30.05.2011
Viim. voimassaolopäivä Sista giltighetsdag (9) 30.05.2016
Haltijan nimikirjoitus Innehavarens namnteckning (10)
Matti Matkailija

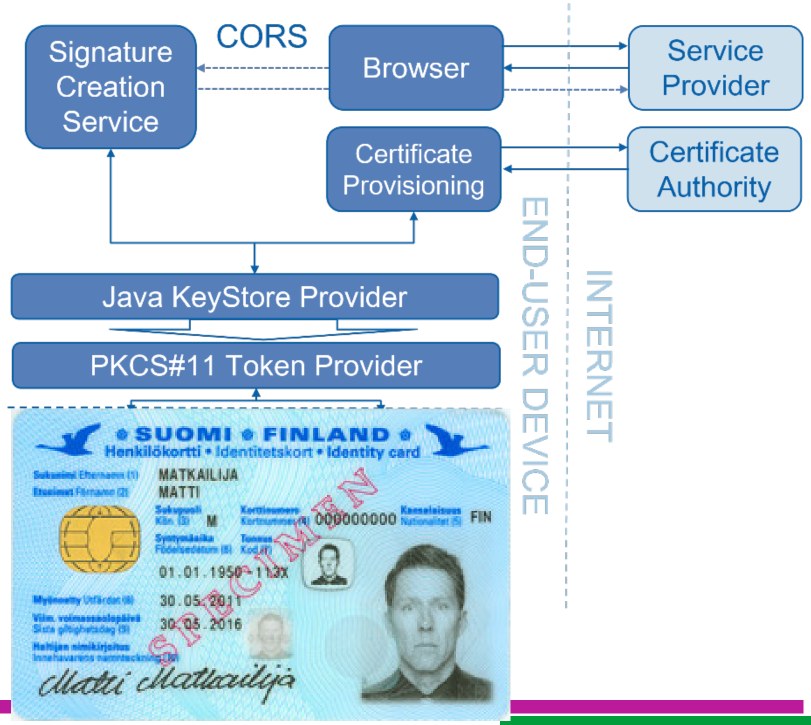
SPECIMEN

- “Mobile PKI” (Mobiilivarmenne)
  - Controlled by mobile carriers

Deploying TEE-based Authentication

What do service providers need in order to improve security/privacy in their services using TEEs?

- Support entire user base:
  - Devices with different types of TEEs, no TEEs
- Showcase: eID scheme specified by VRK
  - TPM 2.0 on a PC
  - Open-TEE on a legacy Android device
  - [Trustonic <t-Base on GS6]



https://se-sy.org/projects/eid/

Developing apps for emerging TEEs

How to make it easy for developers to benefit from emerging new TEE architectures?

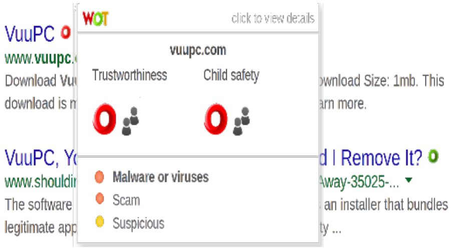
- "Make it easy for developers to benefit from TEEs"
  - On-board Credentials, Open-TEE, …
  - GlobalPlatform standards
- New TEEs are emerging
  - SGX: Servers and PCs
  - TrustLite, SMART, ….: tiny IoT devices
  - Come with their own SDKs, programming paradigms, ..!
- But existing standards are for "split-world" TEEs
  - inspired by "TrustZone"

LookAhead: Augmenting Website Reputation Systems With Predictive Modelling

Can we predict eventual reputation ratings of websites?

WOT WEB OF TRUST

http://mywot.net



VuuPC
www.vuupc.
Download Vu ... ownload Size: 1mb. This
download is m ... arn more.

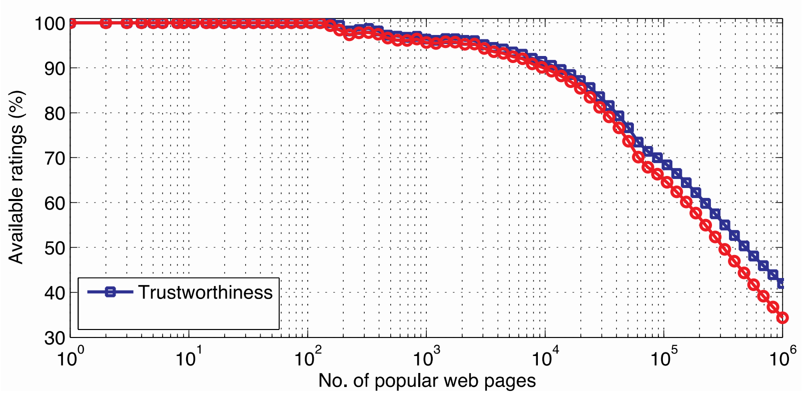
VuuPC, Yo ... d | Remove It?
www.shouldi ... Away-35025-...
The software ... an installer that bundles
legitimate app ... ty ...

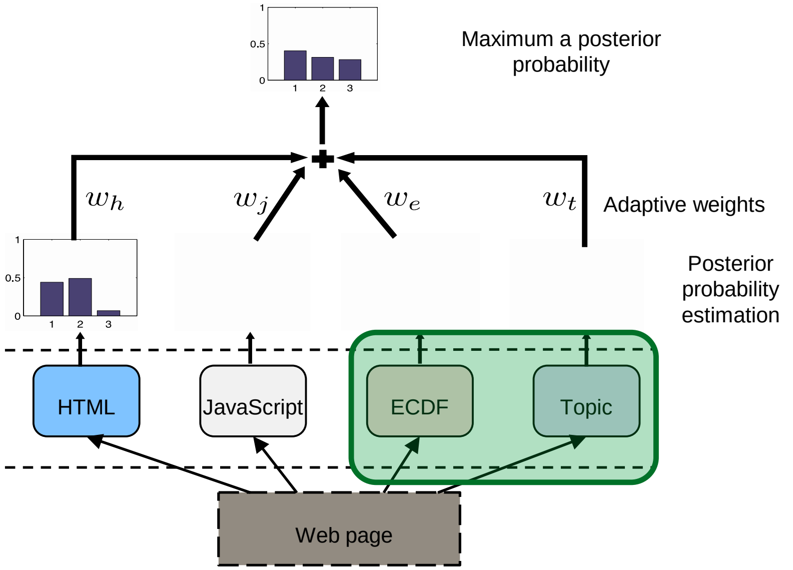
WOT click to view details

vuupc.com

Trustworthiness Child safety

● Malware or viruses
● Scam
● Suspicious





Lack of Coverage (e.g., < 36% of top 1-million pages have child-safety rating)

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WOT WEB OF TRUST

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Kalle Saari

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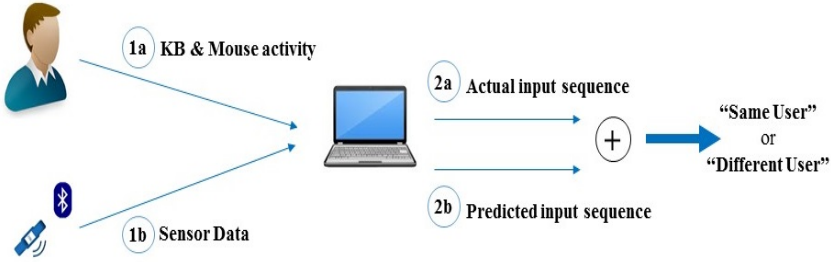
https://se-sy.org/projects/lookahead/

Perils in designing zero-effort deauthentication

How to break a zero-effort deauthentication scheme?

- Deauthentication must be
  - Zero-effort, reliable, fast, cheap
- ZEBRA (IEEE S&P 2014)
  - Bilateral re-authentication
  - Compare “actual” interactions with “inferred” interactions
- We show how to kill ZEBRA



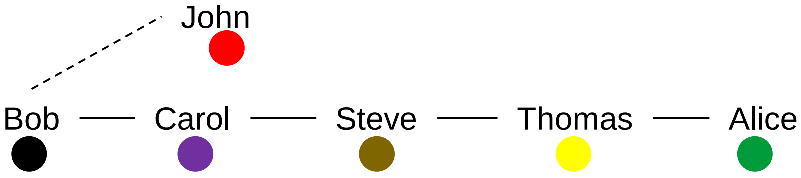
Can still be useful in benign settings

Swapnil Udar

http://arxiv.org/abs/1505.05779

Social Path Lengths of People Nearby

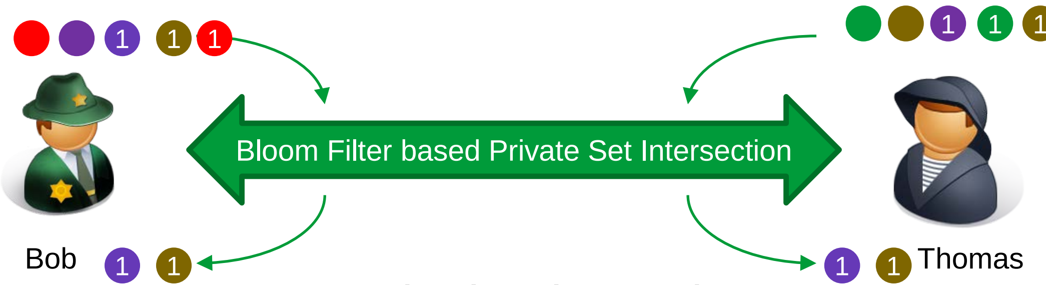
How to determine distance between two people in a social network without sacrificing privacy?



Distribute frienship tokens via social network
Fast Private Set Intersection using Bloom Filters

Friend ID	
Carol	● 1
Anon	1
John	● 1

② + ② = 4
① + ② = 3



D(Bob, Thomas)=3

Friend ID	
Alice	● 1
Steve	● 1
Anon	1

② + ② = 4
① + ② = 3

Marcin Nagy

https://se-sy.org/projects/pet/

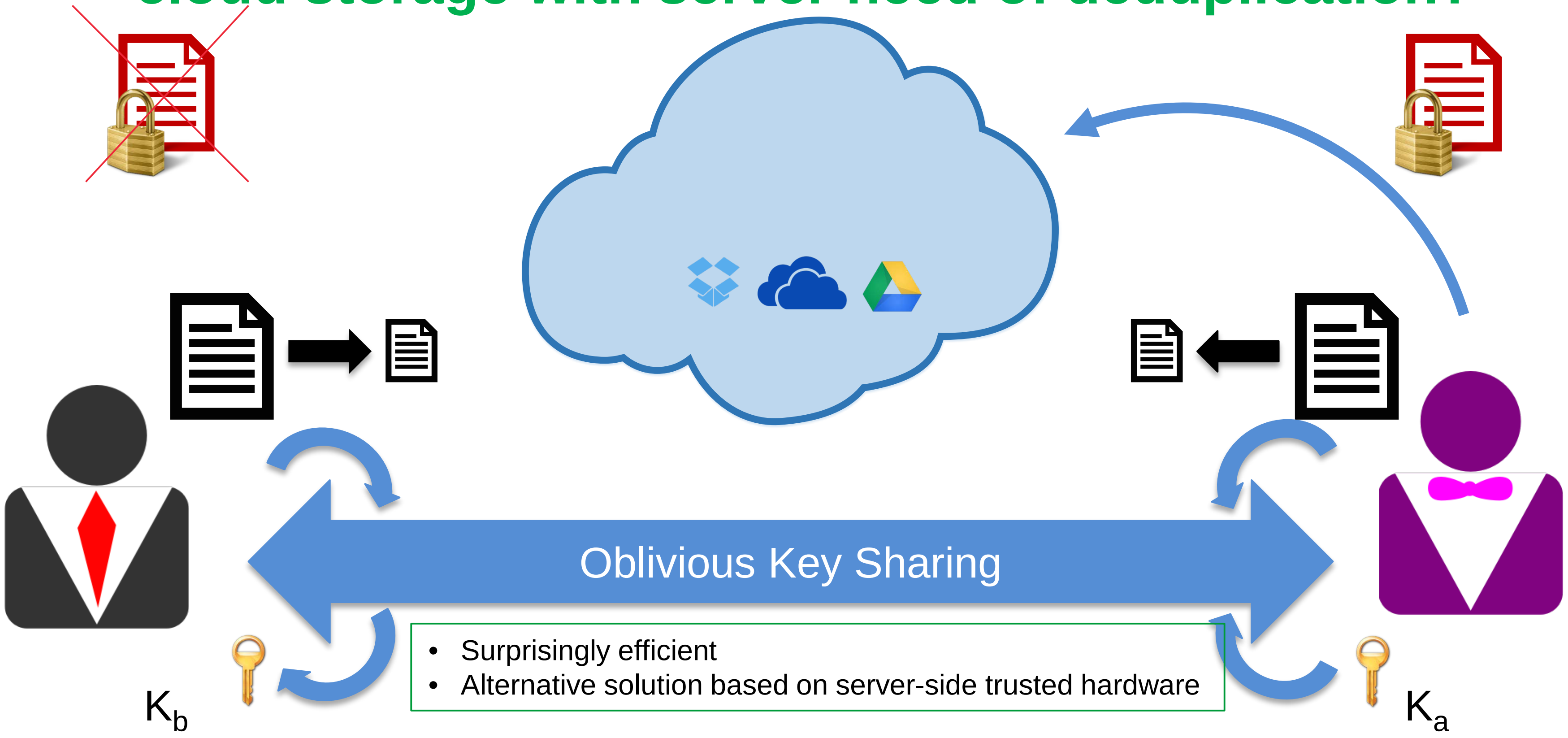
Private membership test with Bloom filters

How to look up a keyword in a cloud-hosted database without sacrificing privacy?

- Server stores the database into an encrypted Bloom filter
- Cryptographic protocol allows client to check bits in the Bloom filter
    - Three different protocols – with various performance and privacy properties
    - Demonstrator for protocol based on Goldwasser-Micali cryptosystem

Secure deduplication of encrypted data

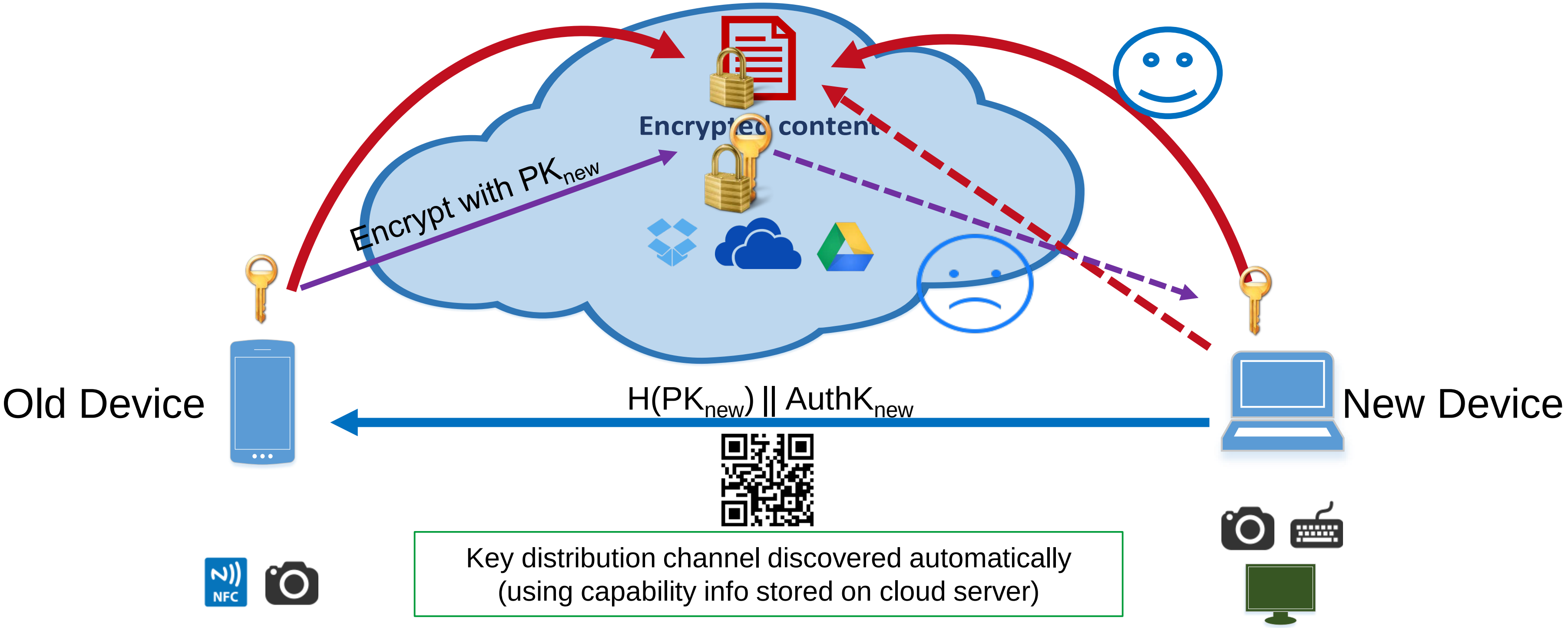
How to reconcile user privacy (client-side encryption) of cloud storage with server need of deduplication?



- Surprisingly efficient
- Alternative solution based on server-side trusted hardware

OmniShare

How to allow users to easily access encrypted cloud storage from multiple devices?



Key distribution channel discovered automatically (using capability info stored on cloud server)

Camera / Display: QR code
display / key board: passcode

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intel
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CloSe
Academy of Finland

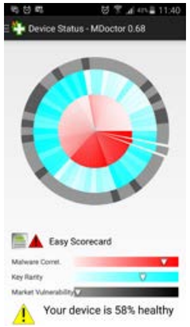
Long Nguyen
UNIVERSITY OF HELSINKI

https://se-sy.org/projects/omnishare/

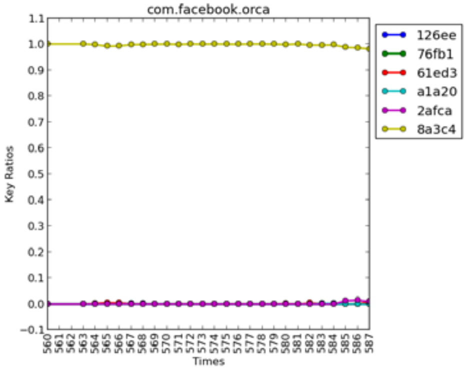
Android Package Signing Key Analytics

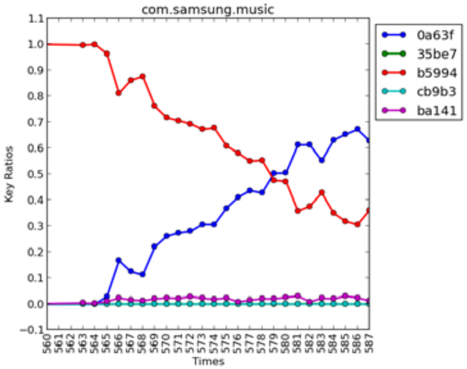
What can we infer from Android package signing key usage patterns in the wild?

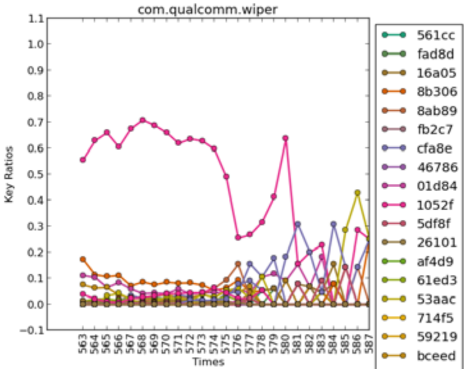
- Android packages are self-signed
- Can key usage patterns help detect malware?



Your device is 58% healthy







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Kati Kyllönen

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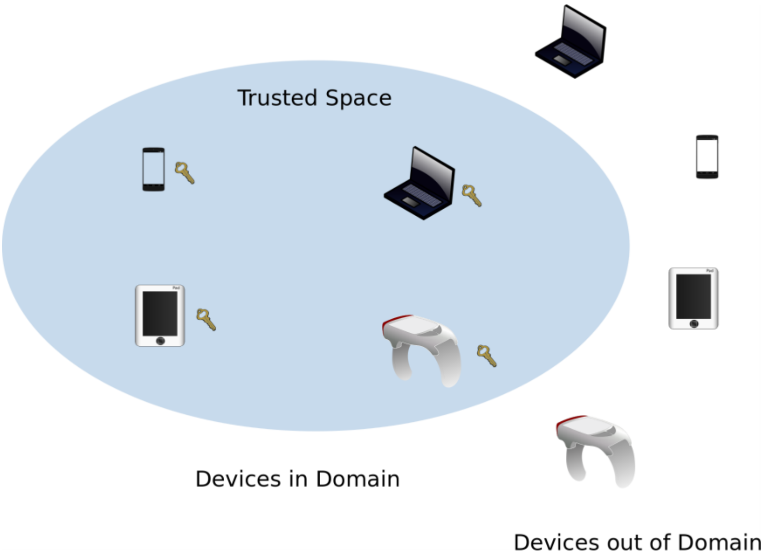
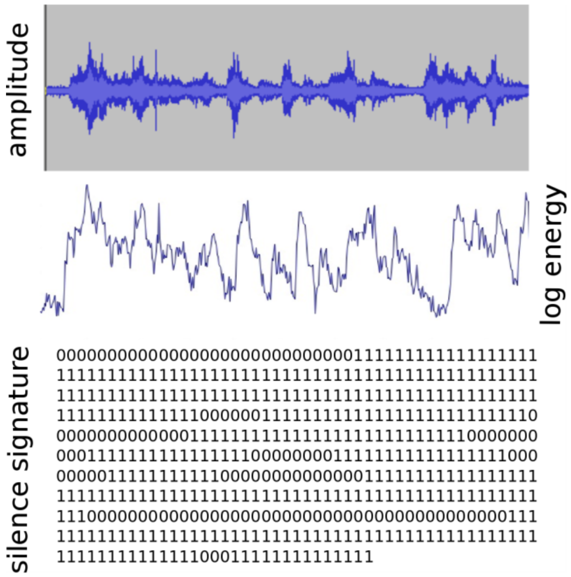
https://se-sy.org/projects/malware/

Whispair: Silence Signatures for Securely Forming IOT Device Domains

How to automatically create groups associations for IoT devices using “silence signatures”





```
000000000000000000000000000001111111111111111111
111111111111111111111111111111111111111111111111
111111111111111111111111111111111111111111111111
111111111111110000001111111111111111111111111110
000000000000011111111111111111111111111110000000
000111111111111111100000000111111111111111111000
000001111111111100000000000000111111111111111111
111111111111111111111111111111111111111111111111
111000000000000000000000000000000000000000000111
111111111111111111111111111111111111111111111111
11111111111111000111111111111111
```

Effective, easy-to-use, privacy-preserving

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Juhani Toivonen

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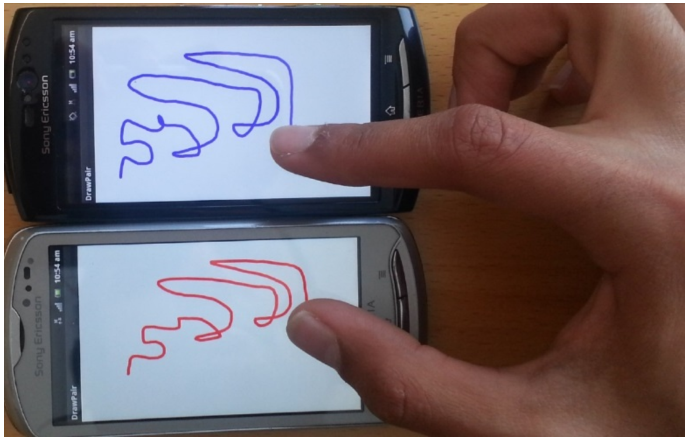
Commitment-based device-pairing protocol with synchronized drawing

Can we replace passwords required in device pairing with … something else?



Pairing touch-screen and touch-surface devices by drawing almost the same picture on two devices with two fingers of the same hand

- Protocol
- Measuring the similarity of the drawings
- Evaluation
- And other remarkably interesting stuff!

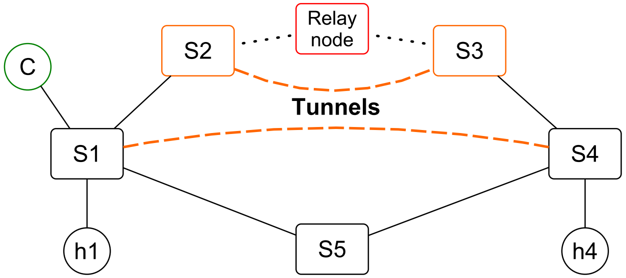
Markku Antikainen

Aalto University ERICSSON

Analysis of Topology Poisoning Attacks in Software-Defined Networks

What can attackers gain by poisoning topology of SDNs?

Motivation: Network-wide visibility is the key innovation of SDN but can be poisoned easily
Goal: To evaluate the significance of the topology poisoning attack in different kinds of networks



Example of two compromised switches with multiple tunnels scenario

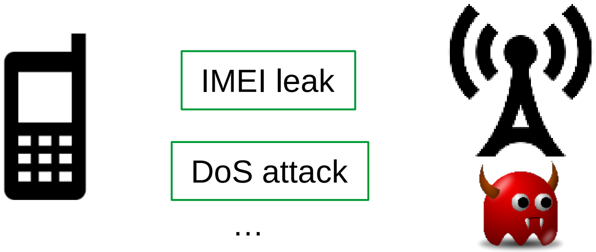
Thanh Bui

Aalto University

Experimental Attacks on LTE Access Networks

How well do LTE implementations guarantee user privacy and availability?

- LTE deployments are progressing fast
- We identify privacy, availability issues in real LTE deployments
- May imply ambiguity in specifications



IMEI leak

DoS attack

…

Thank you for coming!

We appreciate your feedback.