UNIVERSITÄT DORTMUND

Fachbereich Informatik
Lehrstuhl 6 — Informationssysteme und Sicherheit

GI SIG SIDAR & SIG PET WORKSHOP ON
PRIVACY RESPECTING INCIDENT MANAGEMENT

Evaluating the Design of an Audit Data Pseudonymizer Using Basic Building Blocks for Anonymity

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Overview

- APES Basic Building Blocks for Anonymity
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  - Motivation for Evaluation
  - Basic Building Blocks
- Example Anonymity System: *Pseudo/CoRe*
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  - Overview Pseudo/CoRe
  - Specific Building Block Requirements
- Evaluation of *Pseudo/CoRe*
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Anonymity and Privacy in Electronic Services

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Basic Building Blocks for Anonymity

APES: Anonymity and Privacy in Electronic Services

- surveys state-of-the-art anonymity systems:
  anonymous connections, web browsing, e-mail, e-payments, e-auctions, . . .
- anonymity systems decomposed into reusable basic build blocks
  - easier to compare similar building blocks than complex anonymity systems
  - can systematically identify deficiencies given list of building blocks
  - can design anonymity systems by systematically composing building blocks

here: evaluate design of a given anonymity system:

- decompose into building blocks
- compare building blocks used to all similar building blocks to

goal 1) identify room for improvement
goal 2) identify deficiencies

The APES Basic Building Blocks Levels

- building blocks hide or remove identifying information at

  connection level: provide anonymous communication channels

  - information may identify individuals

    implicitly: linking information along connection path by

    appearance: content, format, size, . . .

    flow: exploit knowledge about packet processing: order, timing, . . .

    explicitly (appearance): IP address in packet header, . . .

  - compose building blocks to change appearance and flow

  application level: provide anonymity in an application

  - mostly not *basic* building blocks, rather composed of elementary building blocks not offering anonymity alone

- need to be combined on both levels to achieve anonymity

An Example Anonymity System

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Pseudo/CoRe

Pseudonymization with Conditional Reidentification

Audit Data Pseudonymization

audit data: (=log data)

- can be used to identify individual persons that use a service: performance monitoring, activity profiling

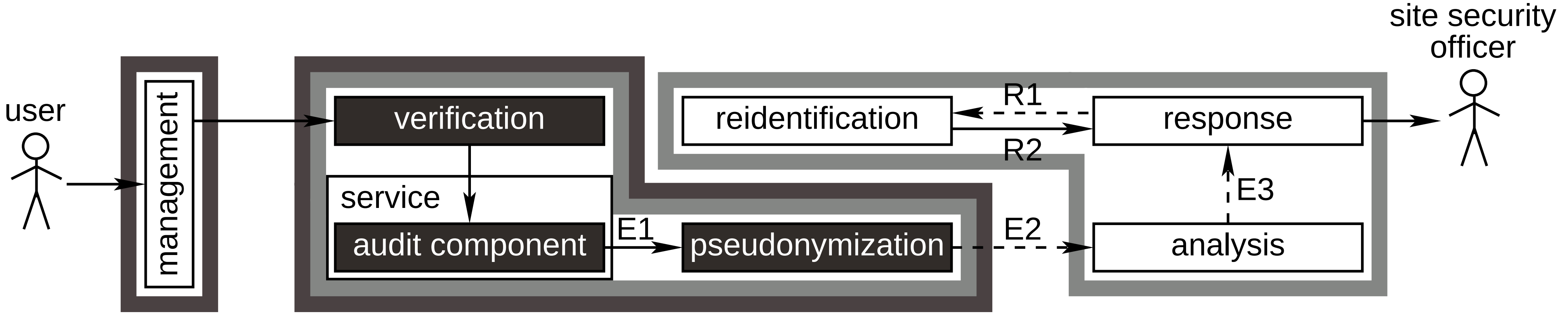
conflicting security requirements:

- accountability of misuse to protect victims
- individual desire for and right on anonymity / privacy

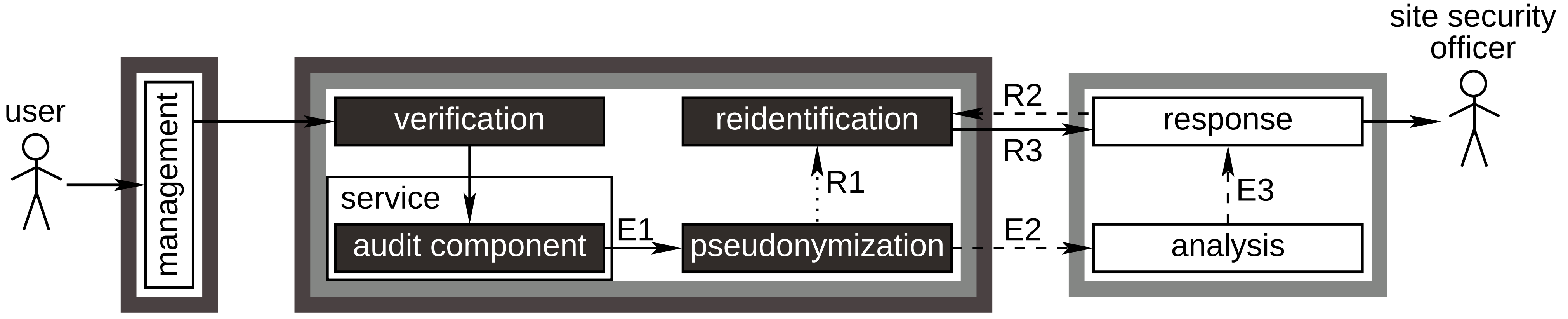
balancing conflicting security requirements:

- replace person identifying features in audit data with pseudonyms
- detection of misuse suspicions possible on pseudonymized audit data
- for a given misuse suspicion accountability can be established: only the involved pseudonyms can be disclosed

Pseudo/CoRe



technical purpose binding



organizational purpose binding

Specific Building Block Requirements

- SSO generally cannot observe user behavior,
  exception: inspection of pseudonymized audit data

⇒ **no connection-level anonymity** required

- channel between audit component and pseudonymizer must be protected,
  easiest if channel is short and local, hence
  pseudonymize on device providing service and generating audit data

⇒ service responsiveness must not degrade substantially (a)

- device may get successfully hacked, hence
  move audit data to a secure location as soon as possible

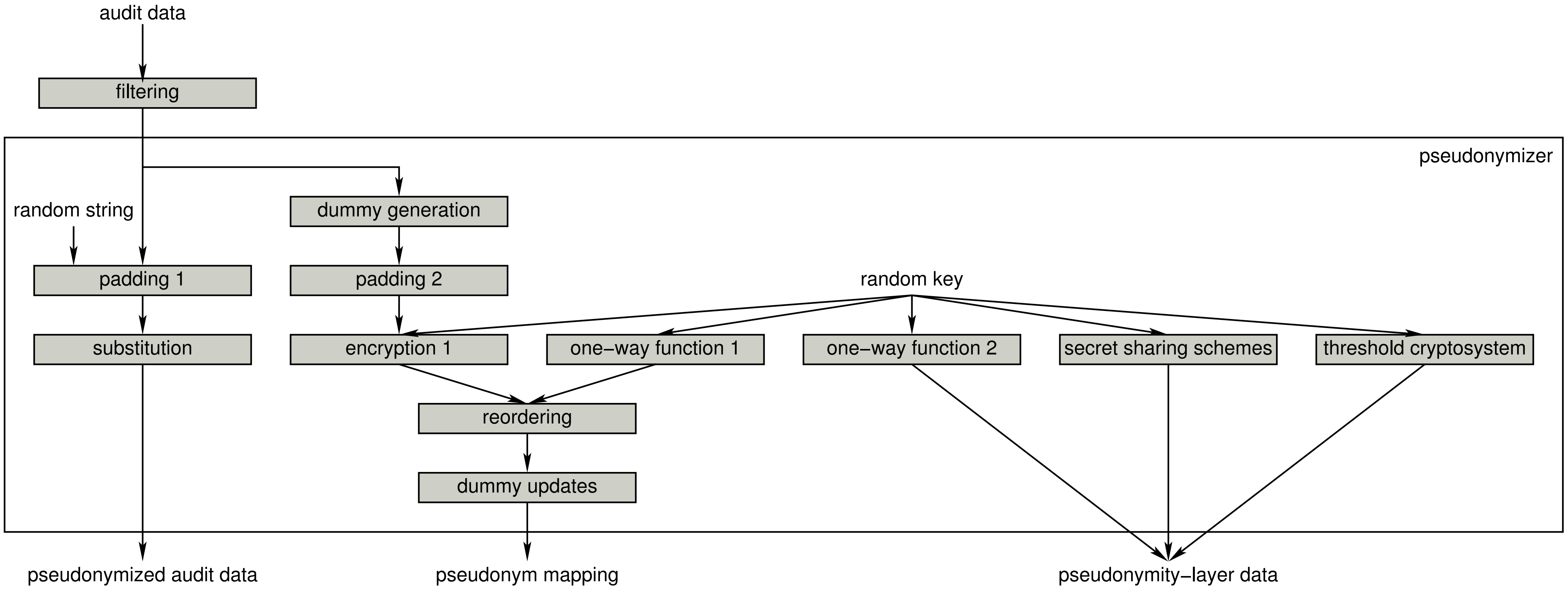
⇒ pseudonymization must: (b)

  - be performed on the fly
  - introduce no significant delay
  - keep up with audit data volume characteristic for the service

(a) & (b) ⇒ building blocks with **low computational complexity** and **low delay**

Evaluation of *Pseudo/CoRe*

Pseudonymization Approach Decomposed



Connection-Level Building Blocks Used

building block	connection-level		application-level	our approach
	appearance	flow		
encryption	√		√	√
padding	√		?	√
substitution	√		?	√
compression	√			—
reordering		√	?	√
latency		√		?
dummy activity		√	?	√
no replay		√		—
filtering		√	?	√
caching		√		—
broadcast		√	√	—
untraceable broadcast		√	√	—
multiplexing		√		—
bulletin board		√	√	—

Application-Level Building Blocks Used

building block	connection-level		application-level	our approach
	appearance	flow		
one-way function	—	—	√	√
(fair) blind signature			√	(?) / —
group signature			√	?
threshold cryptosystem			√	√
multi-party computation			√	?
homomorphic encryption			√	?
deniable encryption			√	—
secret sharing schemes			√	√
zero-knowledge			√	?
pseudonyms			√	? / √
trusted third party			√	√

Evaluation Results

ad goal 1) identify room for improvement

- in the conceptual design under specific circumstances a more efficient building block could be used to hide pseudonym mapping updates
- six build blocks could be used to
  - reduce the power of the TTP
  - replace the threshold cryptosystem
  - provide exploitable properties in of protected pseudonymity layer data
- probably none of the candidate building blocks will either satisfy the specific requirements of audit data pseudonymization wrt. computational complexity or delay

⇒ improvement possible only if requirements are relaxed to trade off stronger mechanisms against computational complexity or delay

ad goal 2) identify deficiencies

- none found

Conclusions About the APES Approach

- it is feasible to decompose the design of a given anonymity system
- informally analyzing the decomposed design can identify weaknesses and/or room for improvement
- the given building blocks for conditional anonymity were sufficient for our design; may be sufficient to build many systems for conditional anonymity
- the classification of building blocks is incomplete
- the list of basic building blocks for anonymity is not exhaustive

⇒ analysis results merely give strong indications based on the current state of knowledge

Contact

Software

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