Privacy Preserving Aggregation of Distributed Mobility Data Streams

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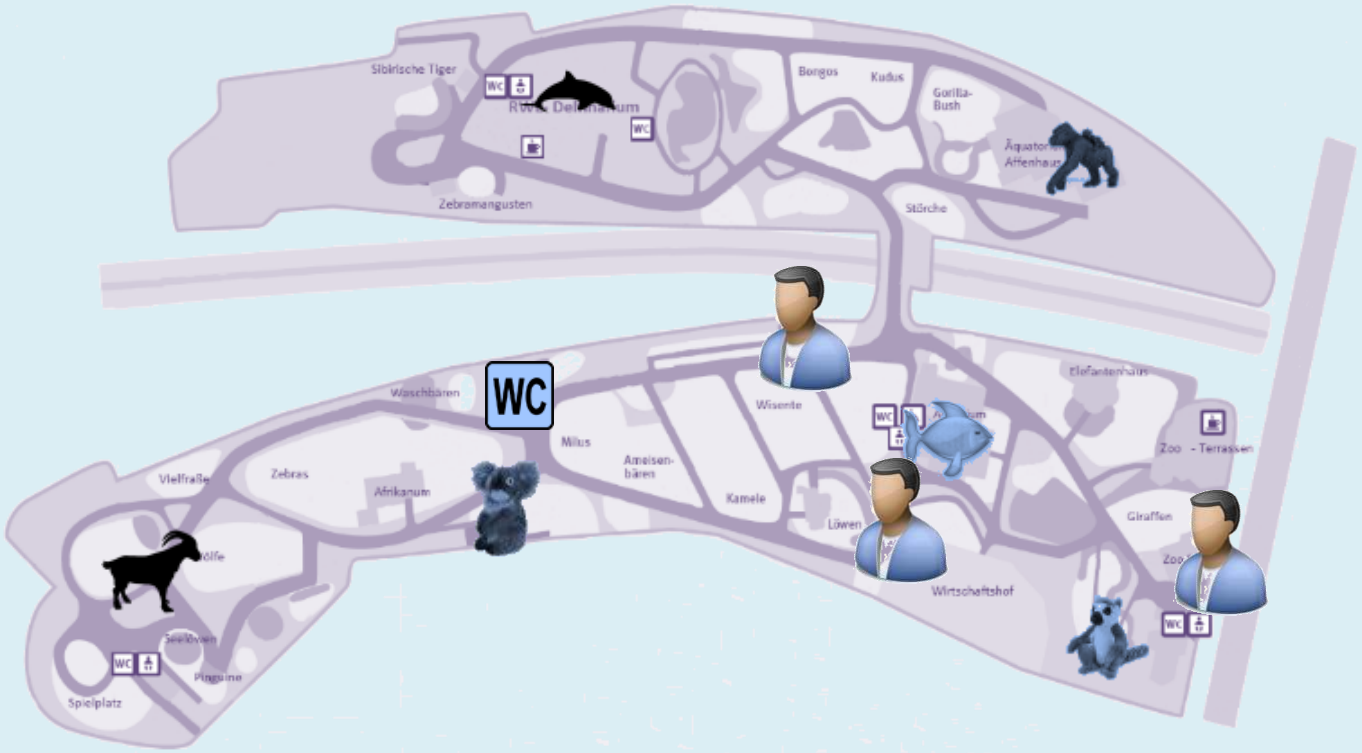
Mobility Data Aggregation Problem

- How many people have been at which location?



Re-Identification problems

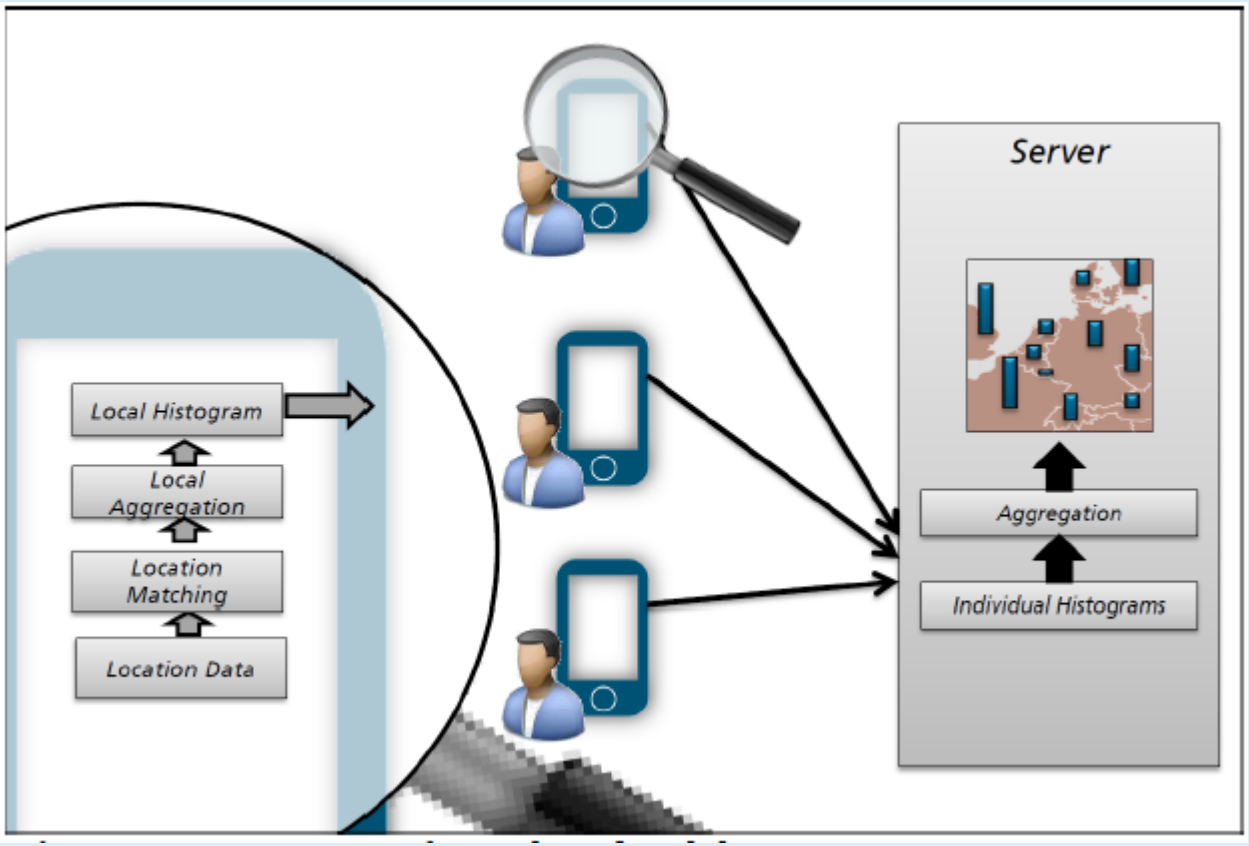
- ❑ removing personal identifier unsufficient
- ❑ sending position information in bulks (trajectories or histograms) unsufficient
- ❑ Easy re-identification in mobility data
- ❑ Intrusted server

→ streaming solution required which prevents server from accessing individual mobility traces

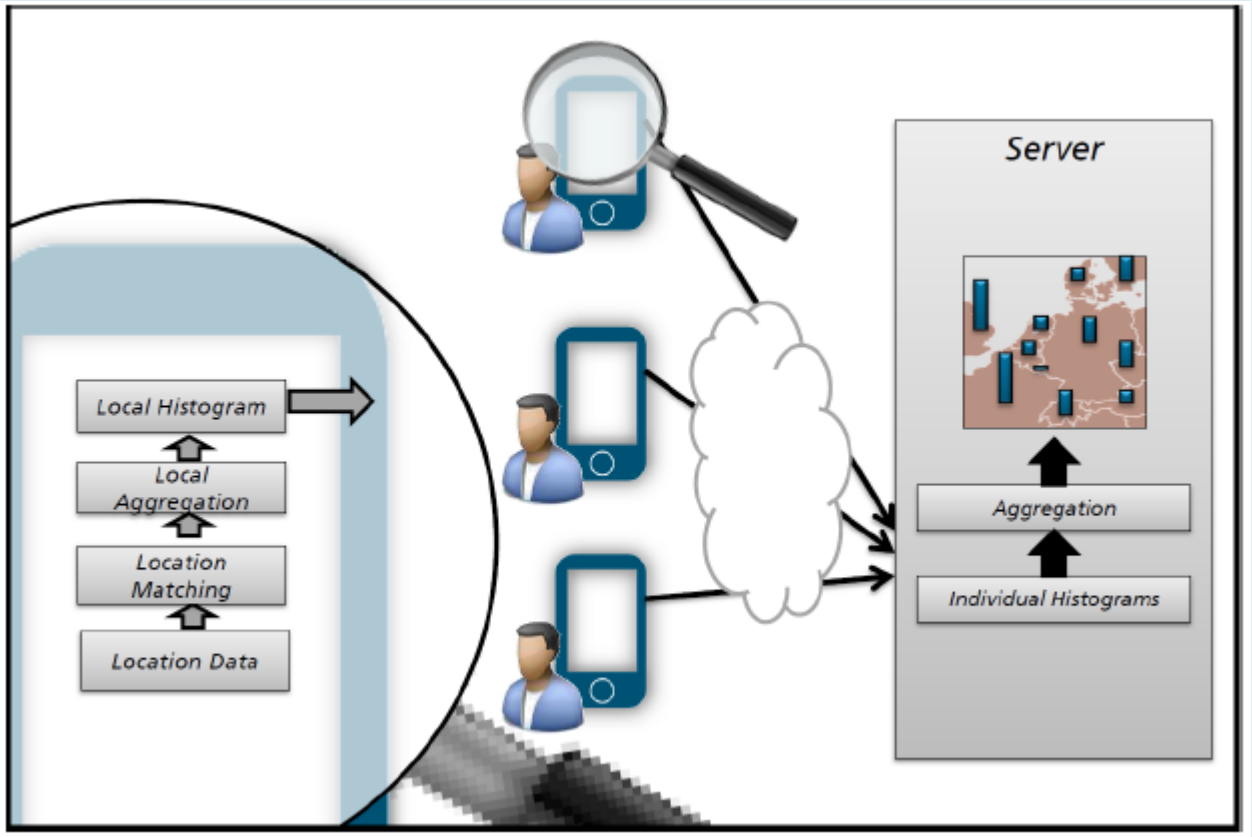
Problem described in [Andrienko et. al. 12] (with many examples and references to laws)

Problem

- secure this aggregation:



Related approach [Kopp et. al. 12]



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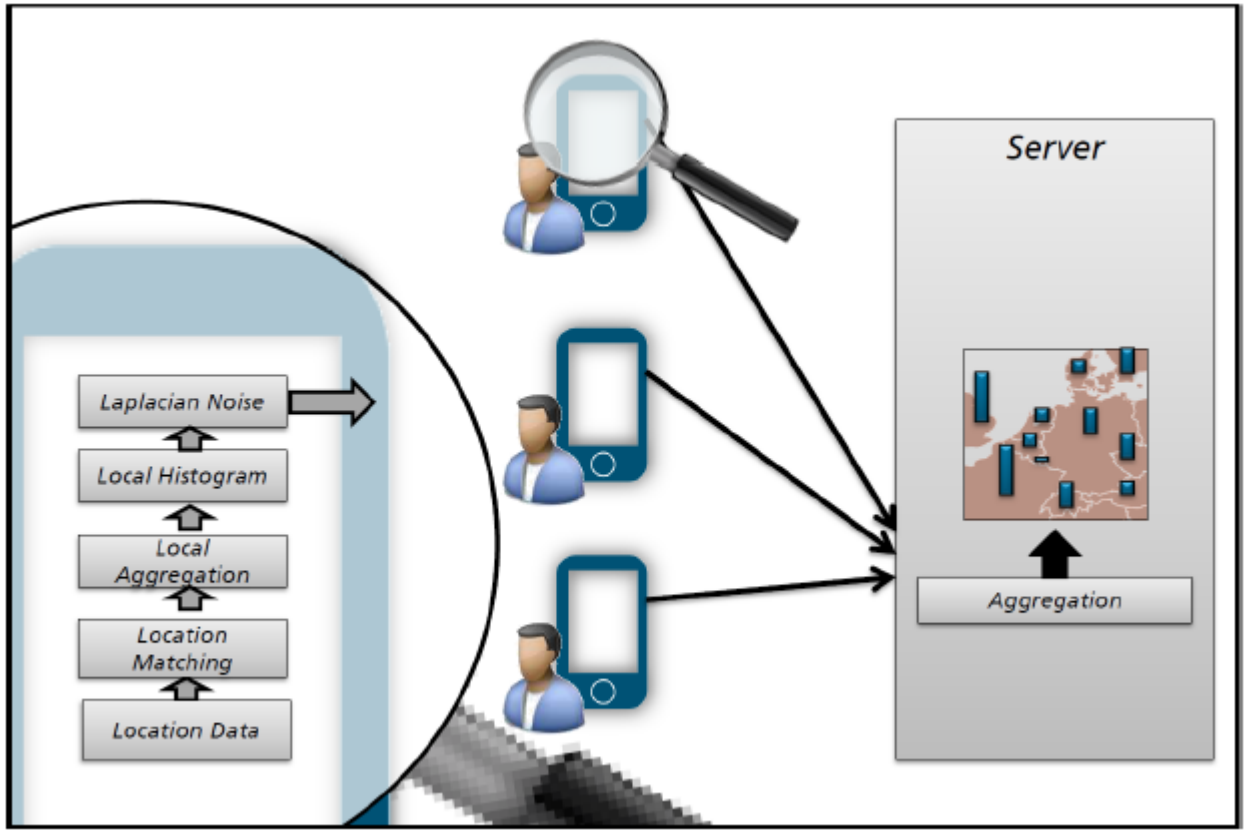

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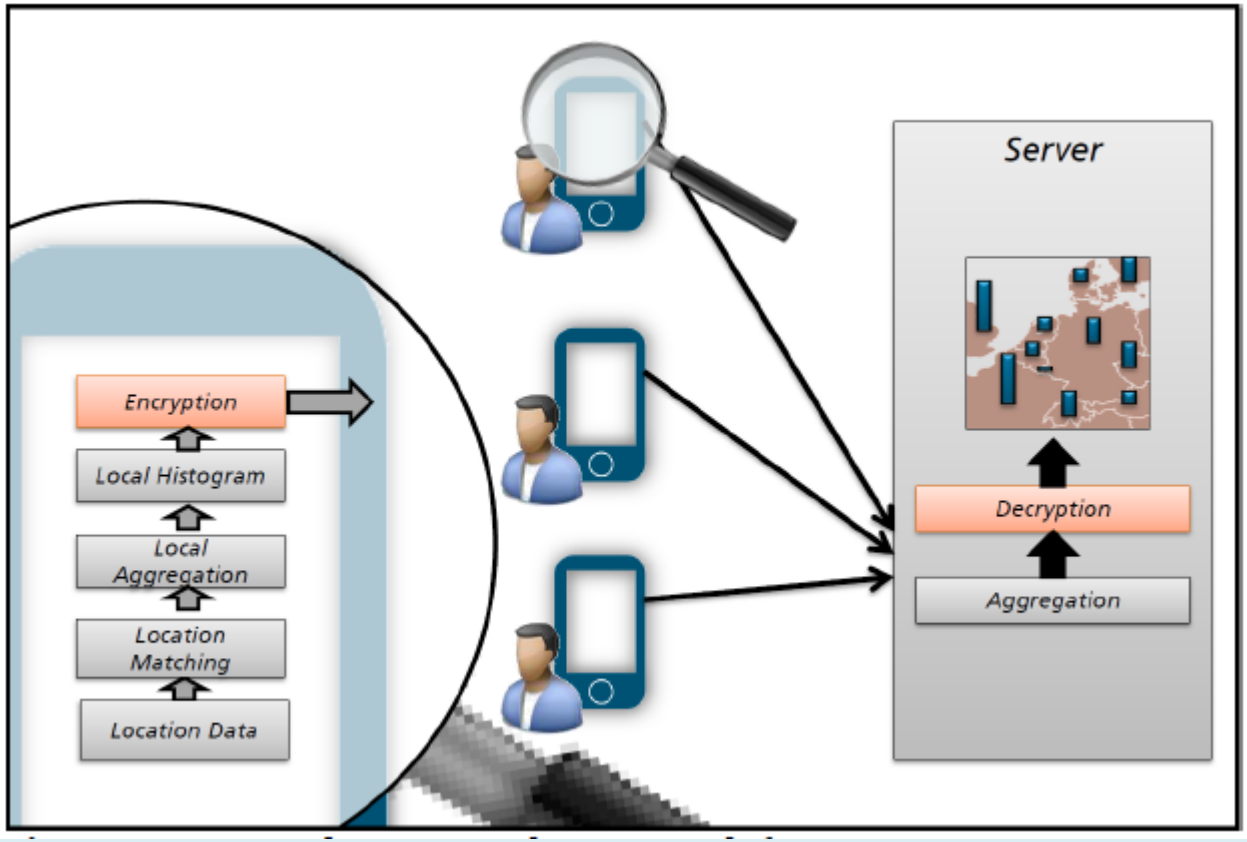
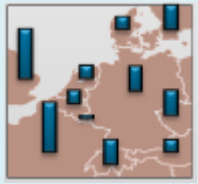
Proposed Solution (3 steps)

- utilize homomorphic encryption



Proposed Solution I (RSA)

- based on two cryptographic keys (like in ssh)



M:=Encryption (H, public key)

Decryption (M, private key)
=
H

Proposed Solution II (Damgaard Algorithm)

- sharing the keys (homomorphic cryptography)

M1:=Encryption (H1, public key1)

M2:=Encryption (H2, public key2)

M3:=Encryption (H3, public key3)

→

Decryption (M1*M2*M3, private key)
=
H1+H2+H3

Proposed Solution III (Hash Chain)

- prevent timimg attacks

Proposed Solution

M1:=Encryption (H1*Ti, public key1)

M2:=Encryption (H2*Ti, public key2)

M3:=Encryption (H3*Ti, public key3)

→ Decryption (M1*M2*M3, private key)
=
(H1+H2+H3)*Ti

Summary

- privacy-by-design concept for mobility stream aggregation
- full utility
- no randomization, no approximation

Next steps:

- further algorithms (clustering, classification, subgroup discovery) without revealing the data

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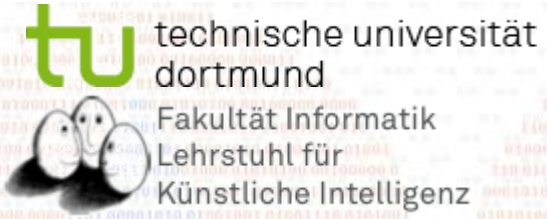

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