Adaptive Location Privacy with ALP

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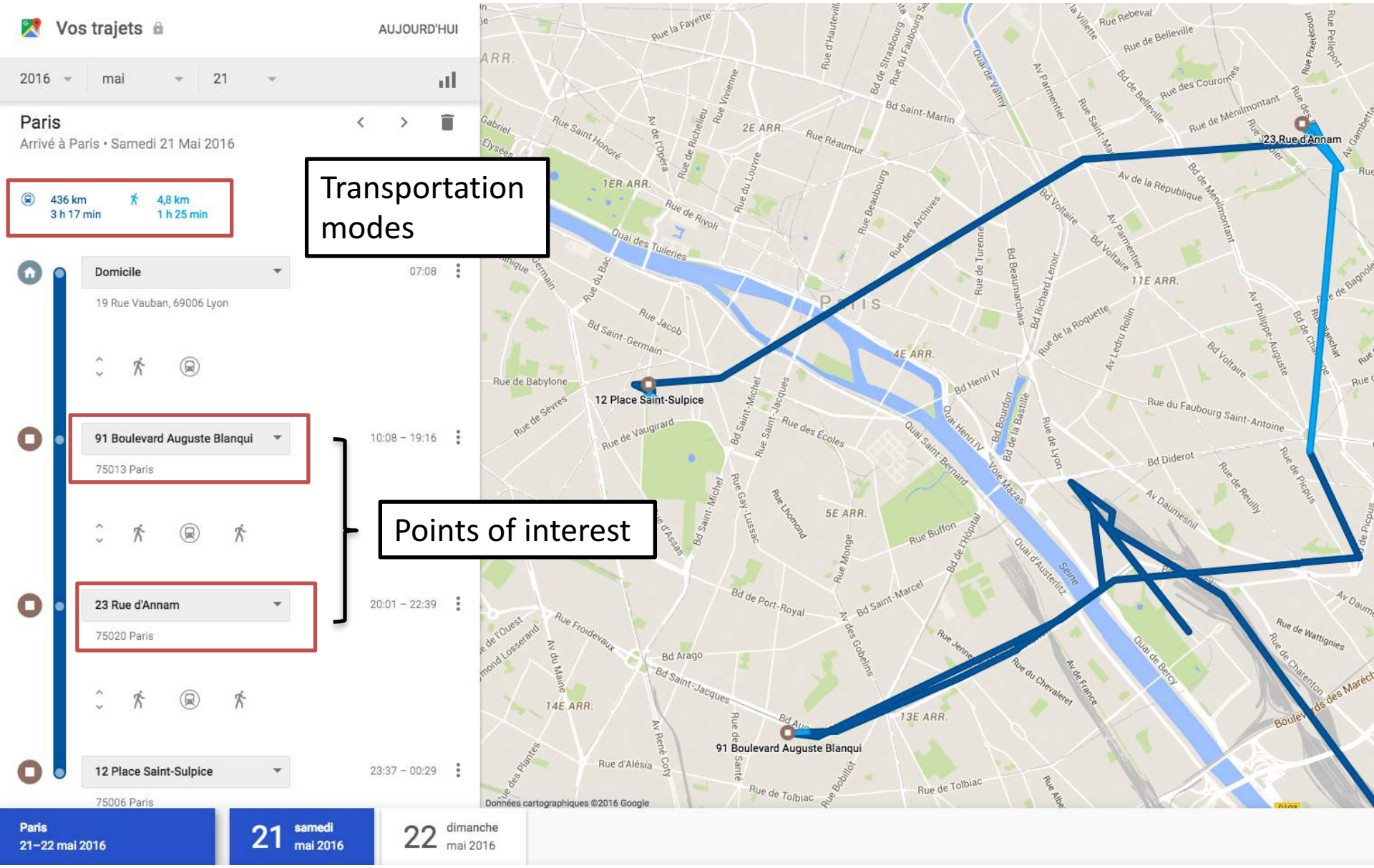
Location-based services

Google, notably through Android

GPS hardware/software manufacturers

Geolocated games

Crowd-sensing platforms

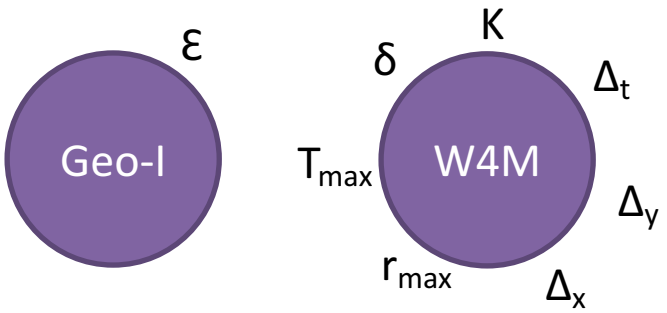


Google Maps Timeline, https://www.google.fr/maps/timeline

Problem statement

Privacy/utility trade-off

Many protection mechanisms, with several configuration parameters.



User-centric configuration

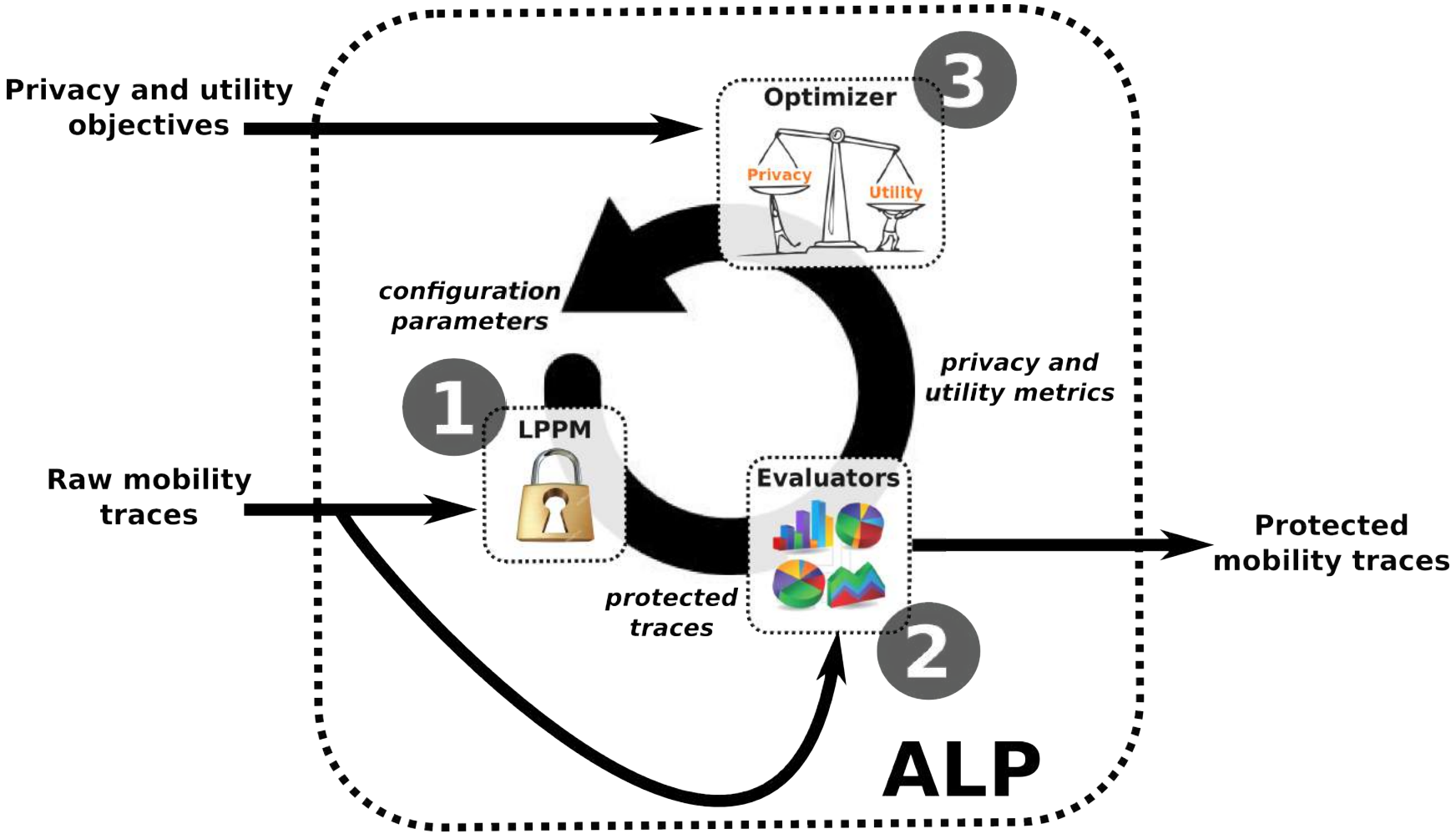
Not every mobility data is equally sensitive and needs to be protected the same way.

Adaptivity

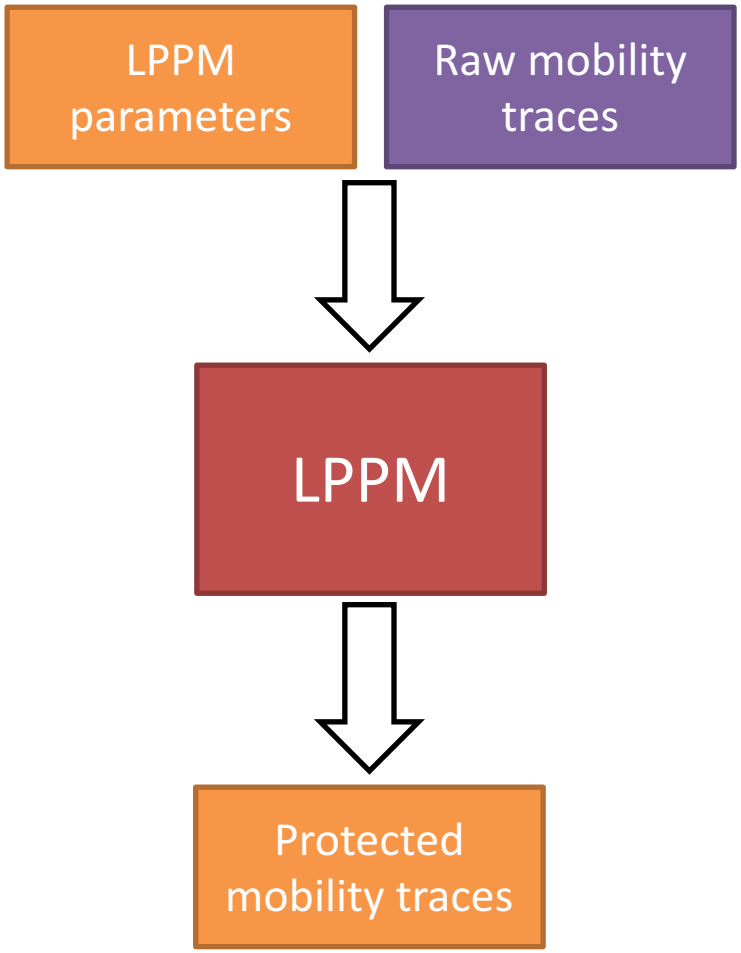
Outline

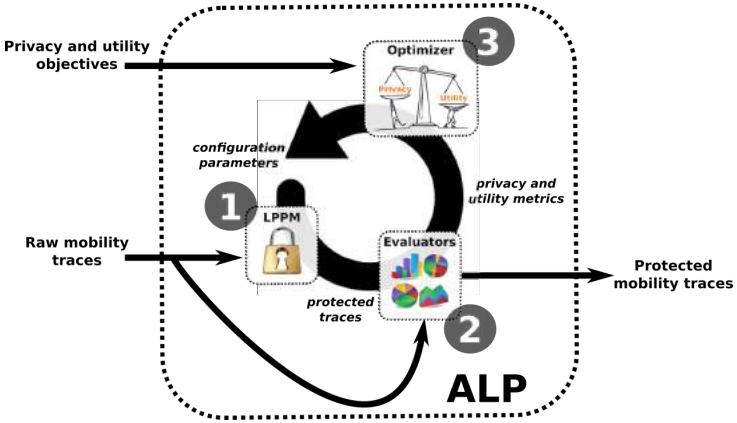
- Introduction
- **Adaptive Location Privacy**
- Experimental evaluation
- Conclusion

The *ALP* framework



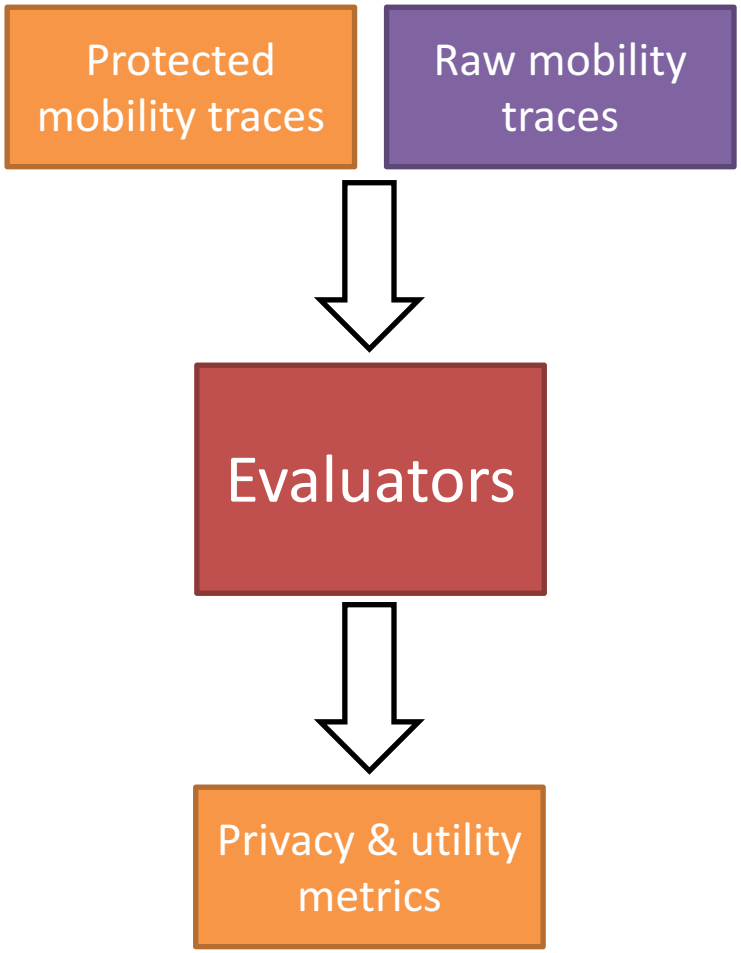
(1) LPPM application

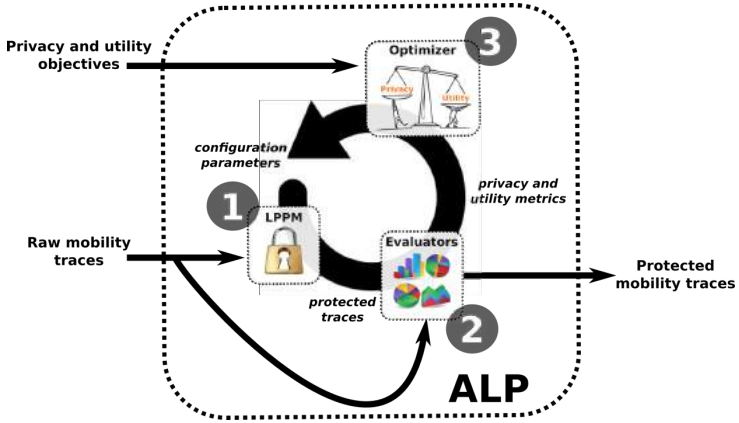




Mobility traces are timestamped locations belonging to a single user.

(2) Metrics evaluation

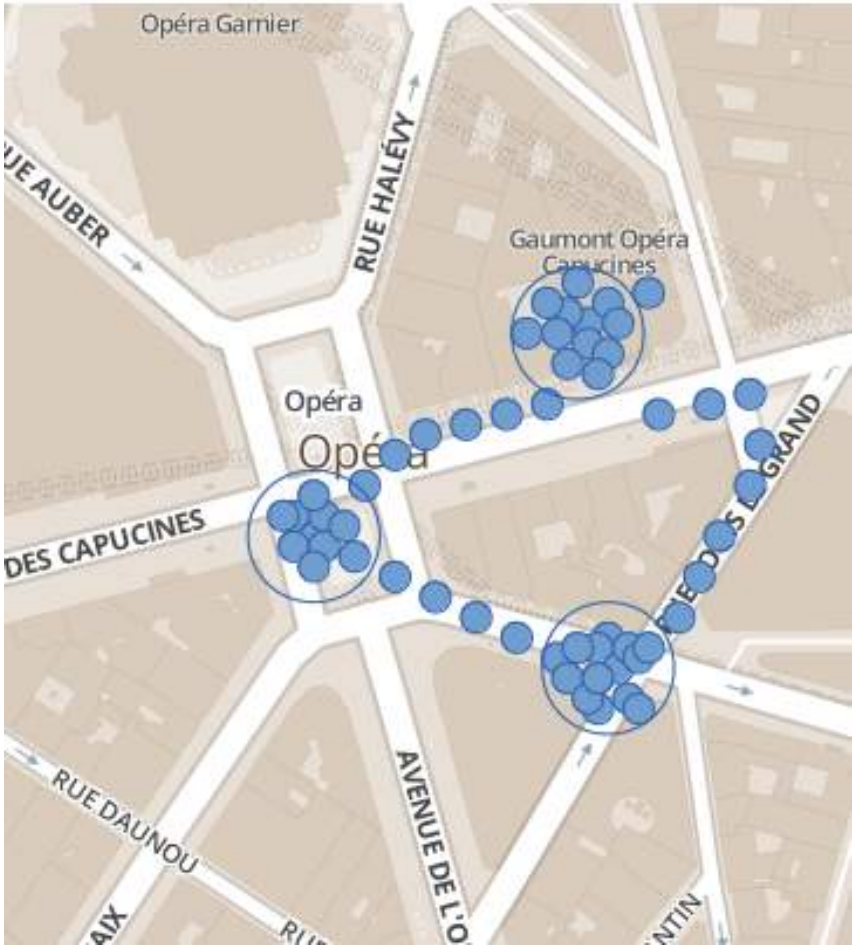




Metrics are evaluated by comparing raw and protected mobility traces.

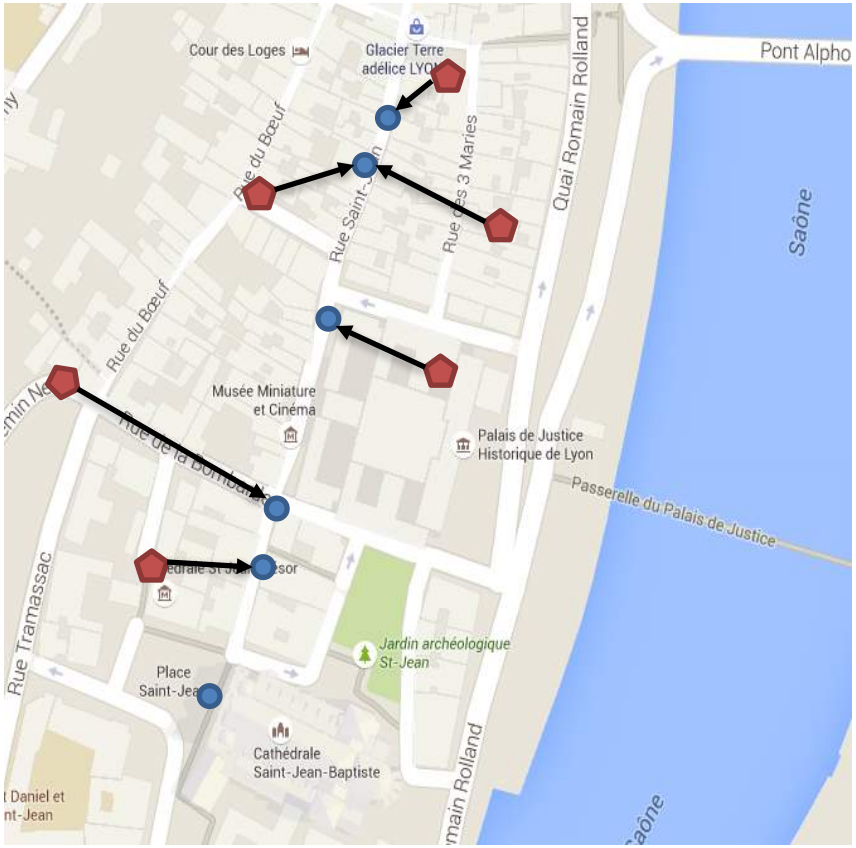
Privacy: POIs retrieval

Points of interest are a well-defined area where a user spent some time.



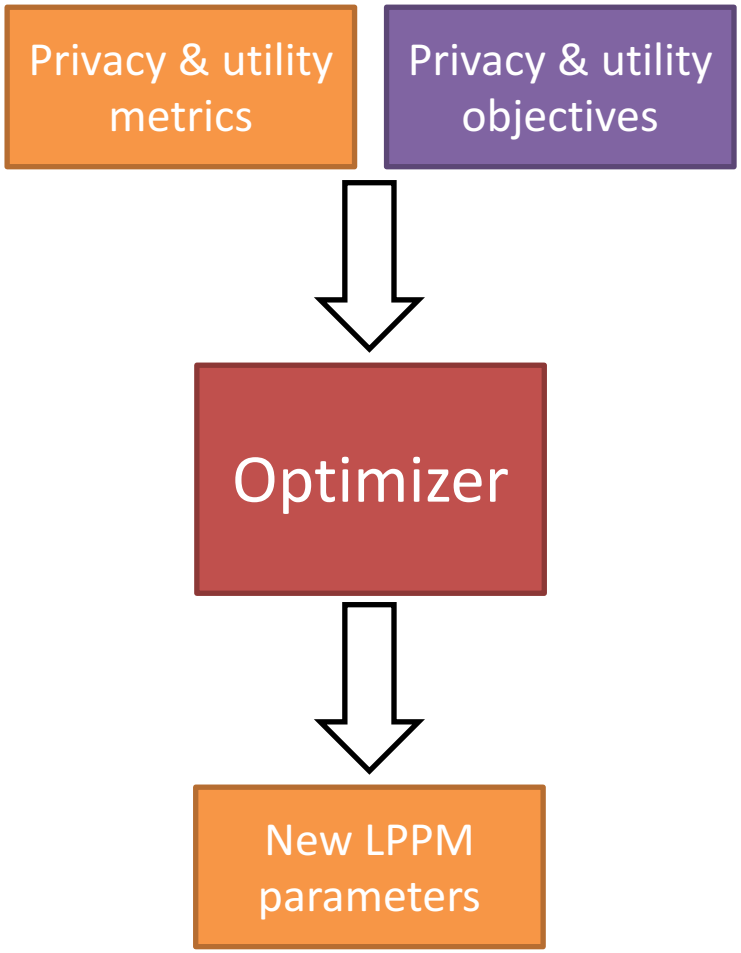
Utility: Spatial distortion

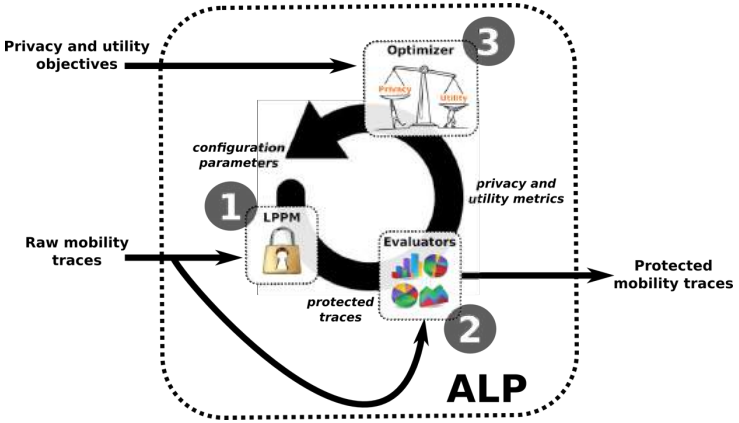
Quantifies spatial imprecision introduced by the LPPM.



Actual location Protected location

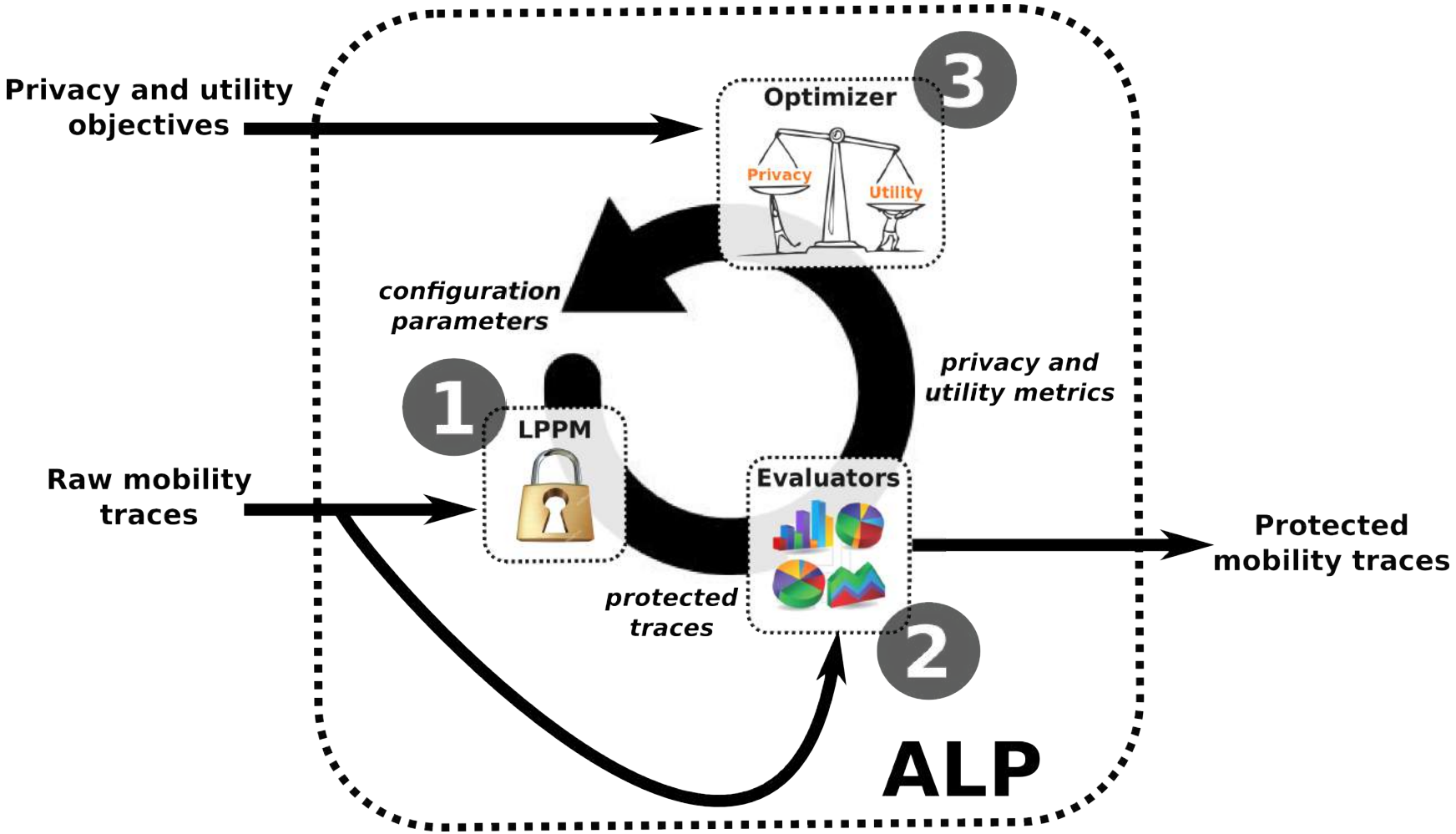
(3) Optimizer





Greedy approach testing various configurations in order to fulfil.

(4) Iterate


Privacy and utility objectives
Optimizer
3
Privacy
Utility
configuration parameters
privacy and utility metrics
1
LPPM
Raw mobility traces
Evaluators
Protected mobility traces
protected traces
2
ALP

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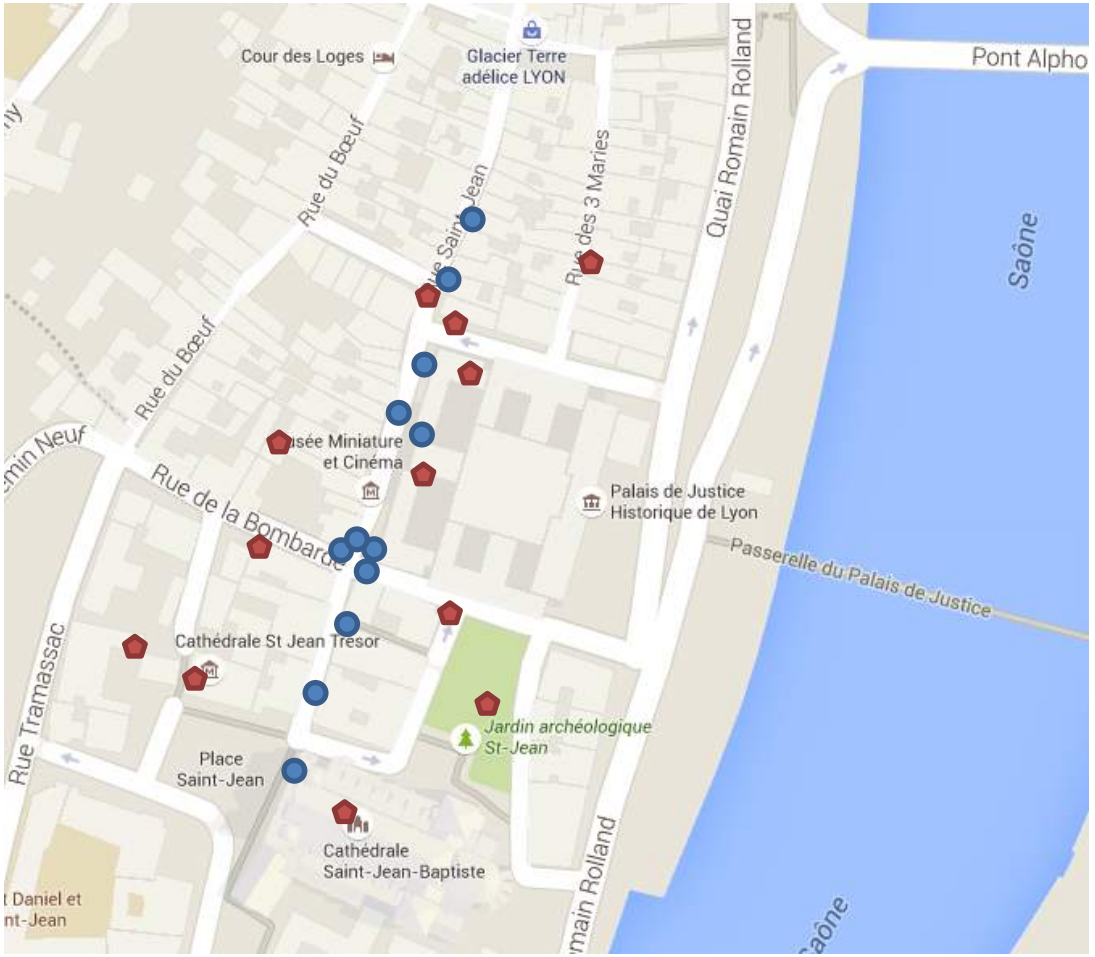
LPPM: Geo-Indistinguishability

Parameterized by **ε**, the amount of noise to add.

ε is expressed in meters^{-1}.



Actual location

Protected location

Geolife dataset

Users	182
Events	25 millions
Duration	4 years
Area	China, essentially around Beijing

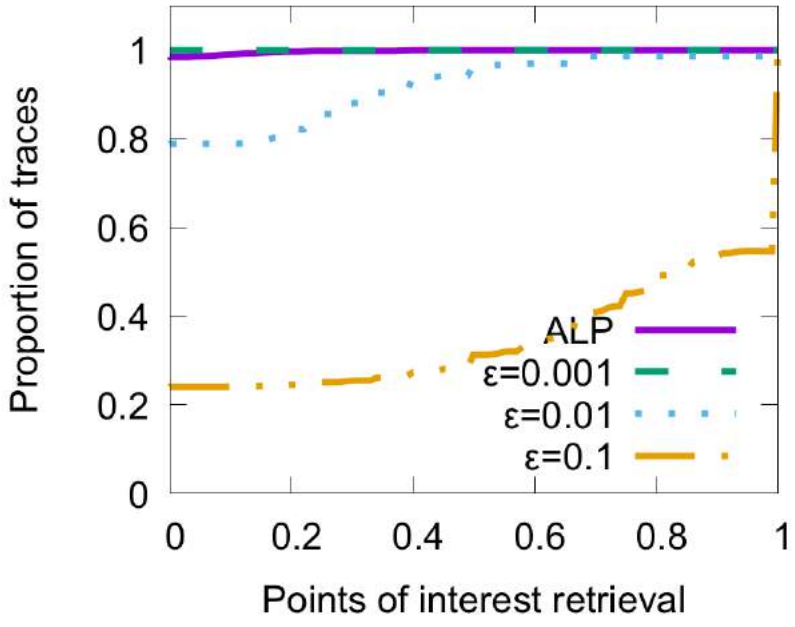
Microsoft® Research

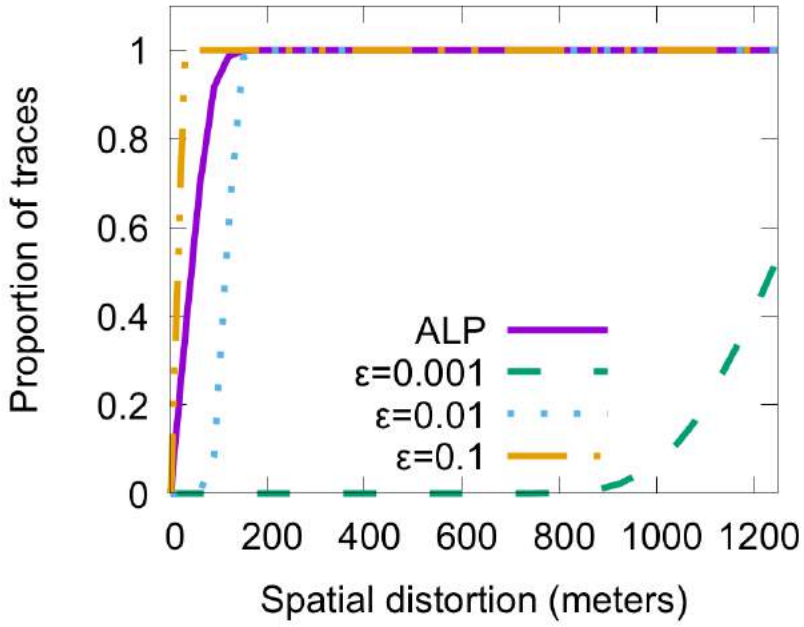
Privacy/utility trade-off

Privacy objective: minimize points of interest retrieval

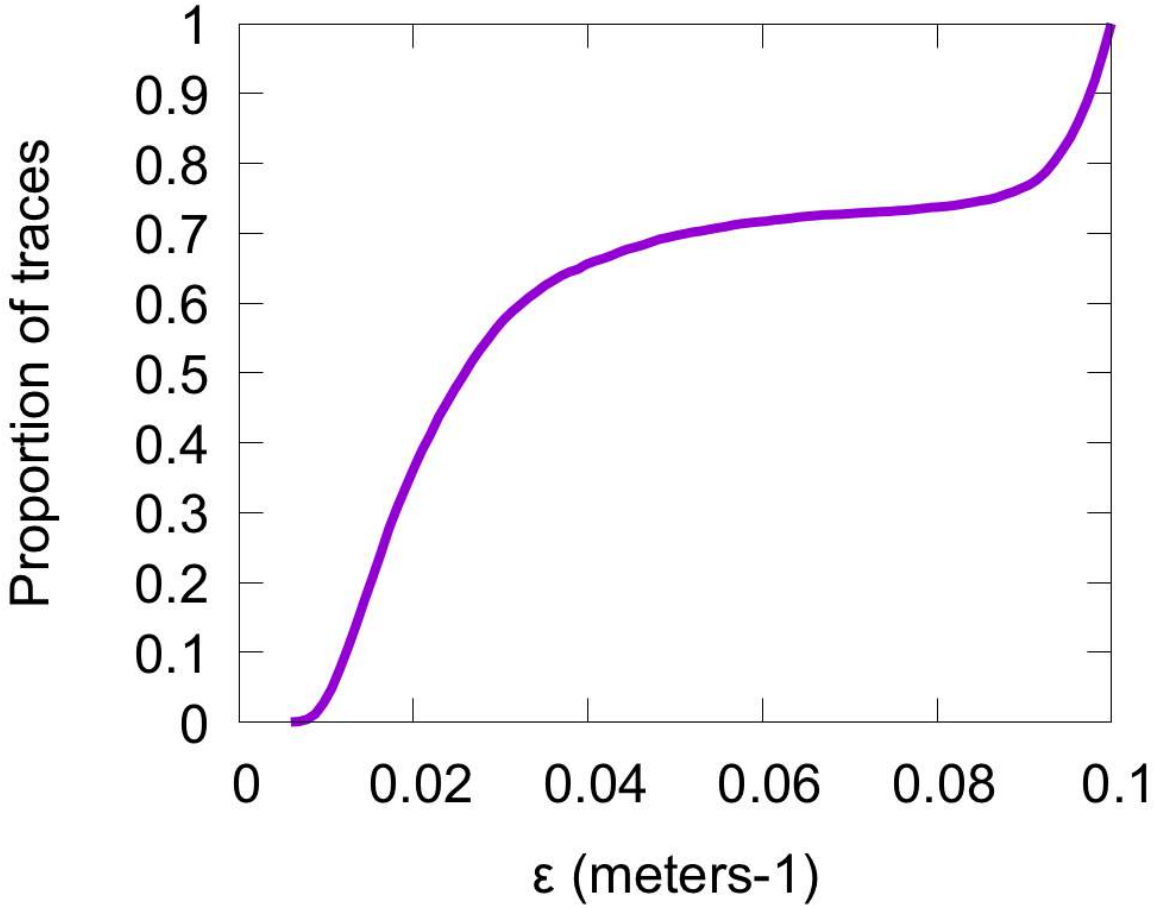
Utility objective: minimize spatial distortion

User-centric configuration





Configuration adaptivity



Execution time

Simulated a mobile device with 1 x 1.2 GHz and 1 Go of RAM.

9 seconds for a 1-day long mobility trace (average)

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Conclusion

Framework for automatic LPPM configuration.

Evaluation showing that a non-technical user can obtain an efficient configuration.

Implementation available at:
https://github.com/privamov/alp

Future work

Integrate more and richer evaluation metrics.

Give the final user a nice GUI to fix his objectives and see their effects.

Thank you!

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