Privacy-preserving Smart Cities

¿utopia or reality?

Carmela Troncoso
(IMDEA Software Institute)
Smart City Expo World Congress
18th November 2015

(Big) data

(Big) data

Data processing & analytics

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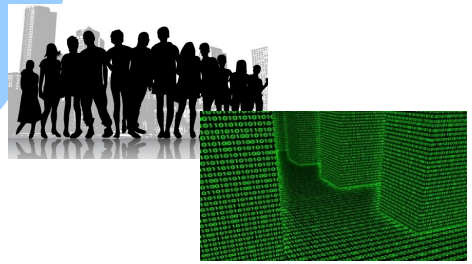

Data processing & analytics

- Whereabouts
  - Shopping
  - Religion
  - Restaurants
- Relationships
  - Friends
  - Professional
- Habits at home
- ...

(Big) Personal data

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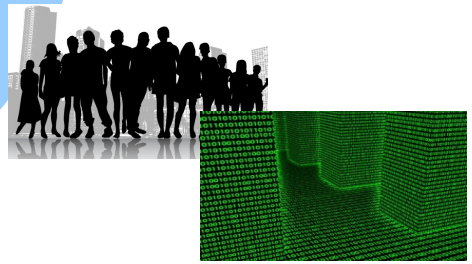

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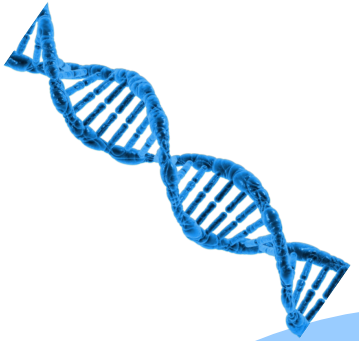

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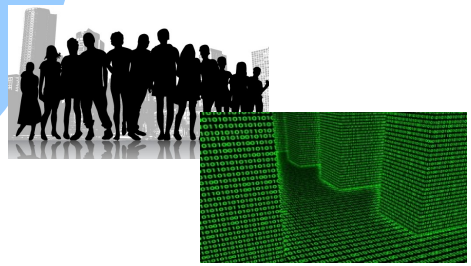

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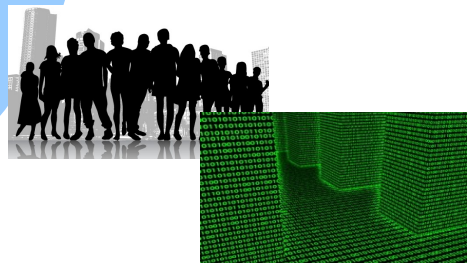

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Data processing & analytics

1) Ethical issues, public opinion
2) Legal framework – Data Protection:
   - consent
   - proportionality
   - purpose limitation

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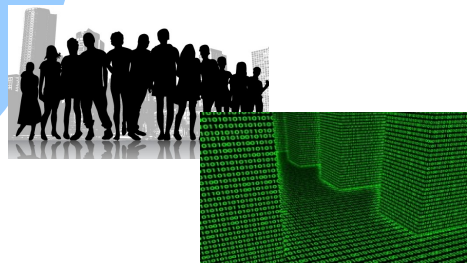

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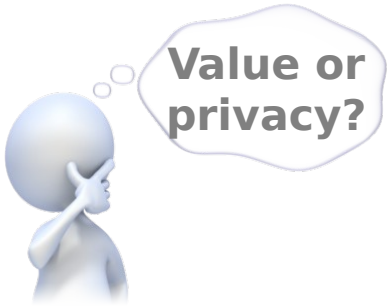

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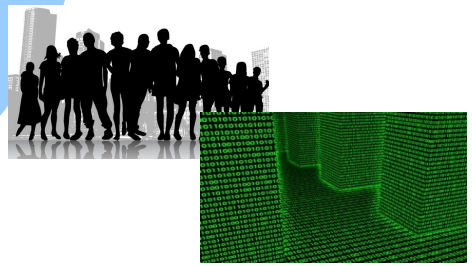

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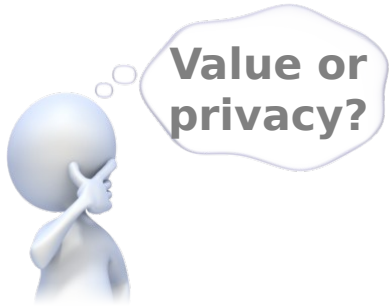

Two technological paths to reconciliation

- Data anonymization
- Advanced cryptography (processing in the encrypted domain)

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Anonymization

EU legislation evolves to harder constraints Art. 29 WP's opinion on anonymization techniques

3 criteria for anonymization

1- No singling out of individuals

Metadata are unique!

- **Location**:
  - "the median size of the individual's **anonymity set in the U.S. working population is 1, 21 and 34,980**, for granularity of a census block, census track and county"
  - "if the location of an individual is specified hourly, and with a spatial resolution equal to that given by the carrier's antennas, **four spatio-temporal points** are enough to uniquely identify 95% of the individuals." [15 montsh, 1.5M people]"
- **Browser**: "83,6 % of browsers have unique fingerprints"
- **Demographic**: "It was found that 87 % (216 million of 248 million) of the population in the United States had reported characteristics that likely made them unique based only on {5-digit ZIP, gender, date of birth}"
- **Credit card transactions**: "need four purchases to identify an individual on the anonymizied credit card records, or three purchases if the prices are known" [3 months 1.1 million people]

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2- No linking data from one individual

- **Social network data**: take two graphs representing social networks and map the nodes to each other based on the *graph structure alone*—no usernames, no nothing (**Netflix Prize, Kaggle contest)**
  - Techniques to do this automatically

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3- No inference about individuals

- **Location**: infer workplace, home, religion,...
- **Energy**: infer concrete appliances, home habits

...

What is data analytics about?

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Anonymization

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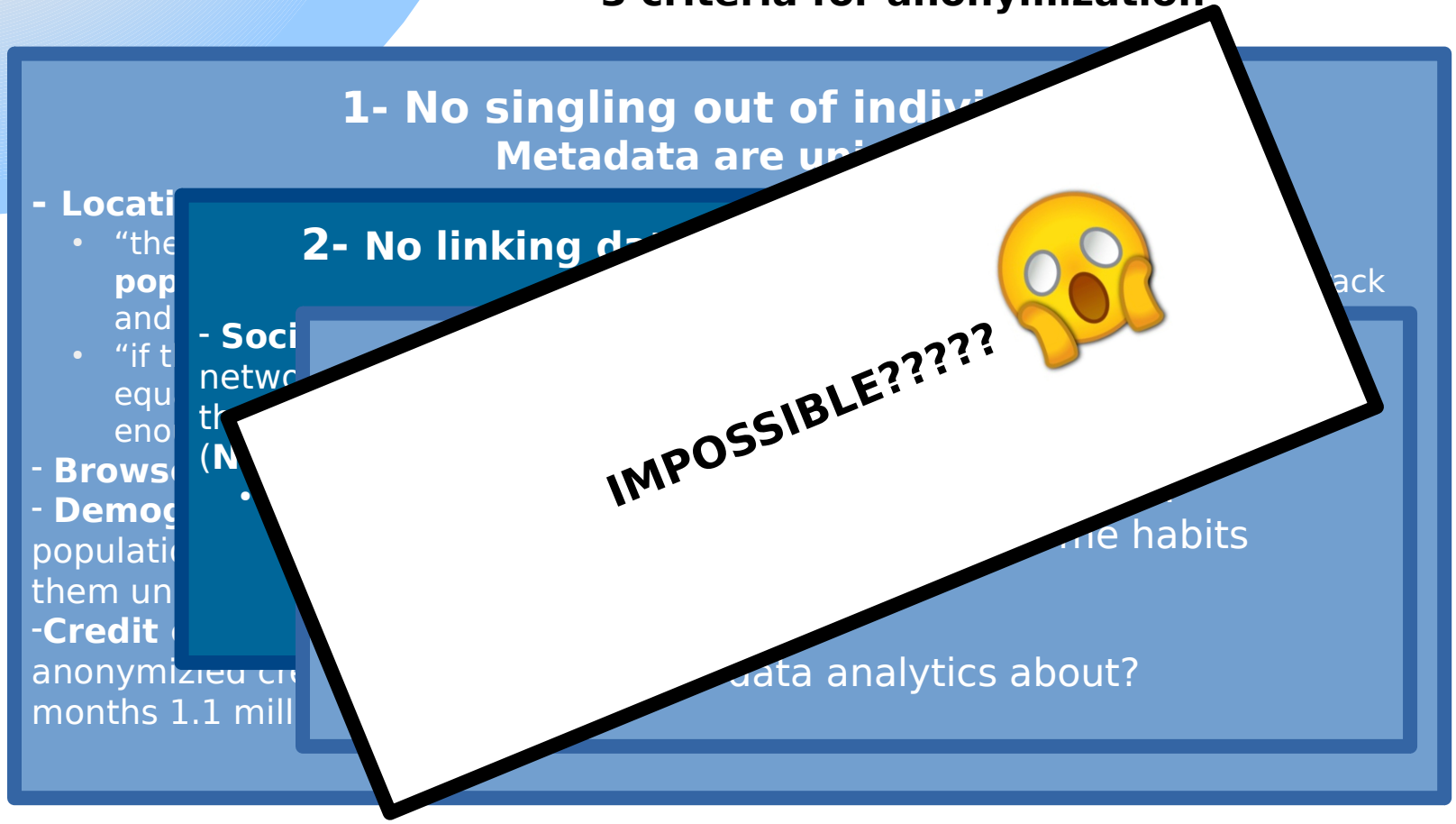

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IMPOSSIBLE IS NOTHING

Art 29 – Risk of de-anonymization

- Traditional identification suppression methods will not do the trick (hash, encryption, random noise…)
- But…
  - We can evaluate anonymity degree and remaining information
  - General anonymization ← little utility
  - Targeted (application dependent) anonymization ← better utility

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Advanced cryptography
Processing in the encrypted domain

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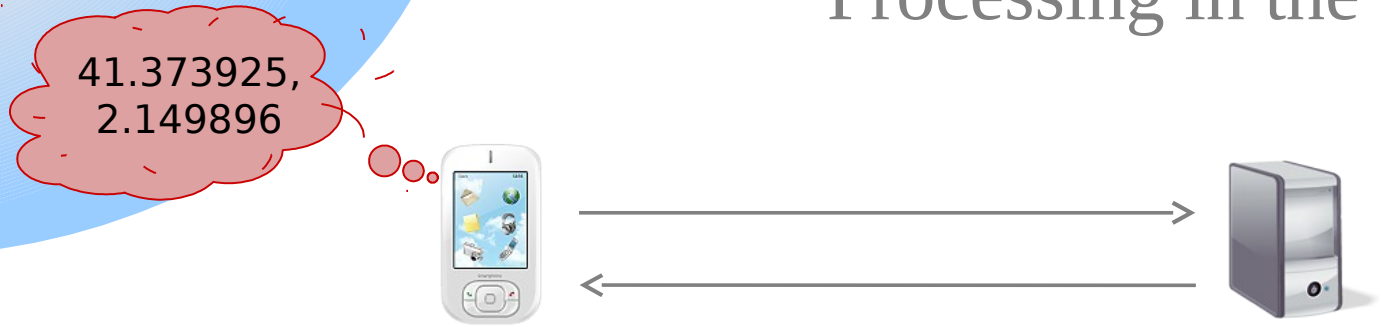

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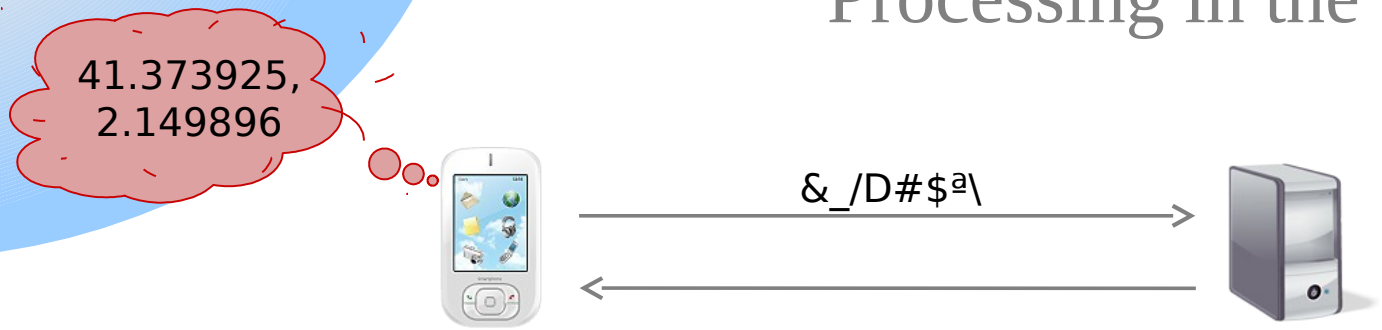

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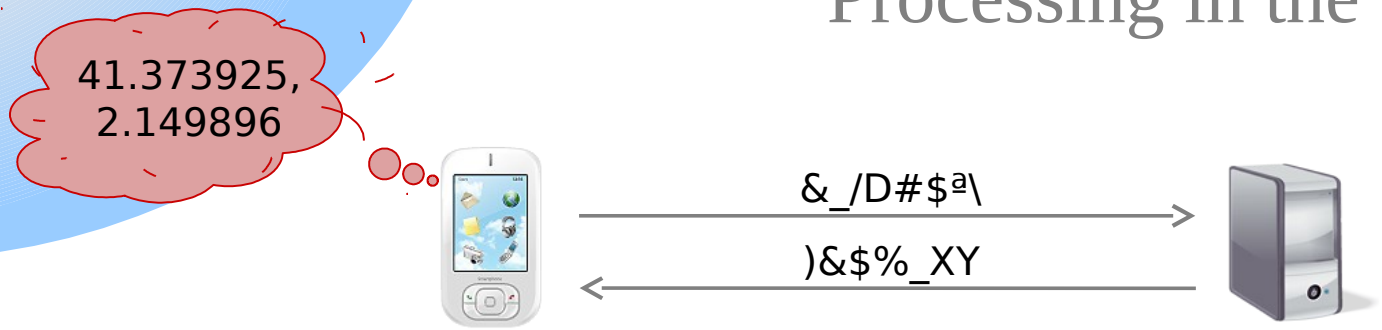

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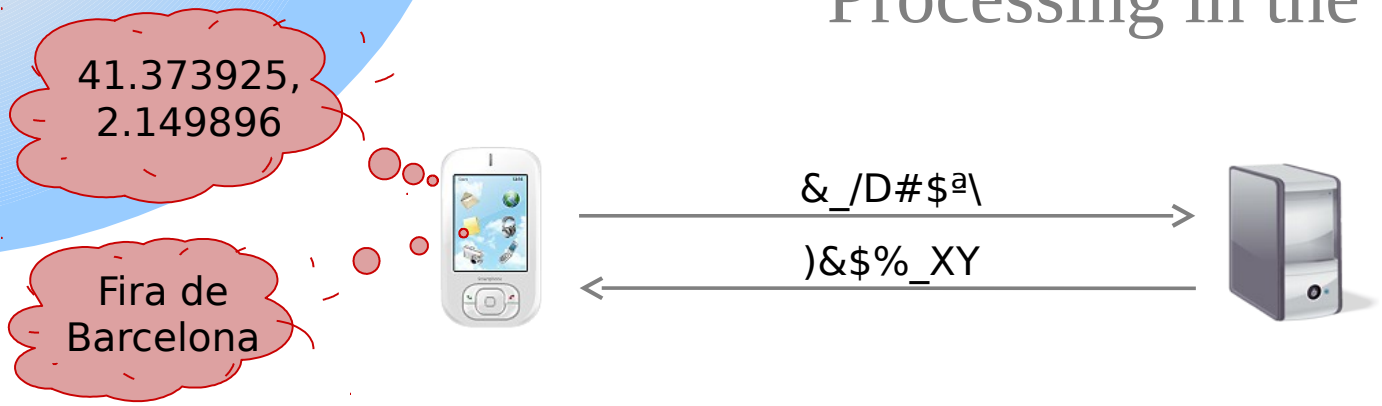

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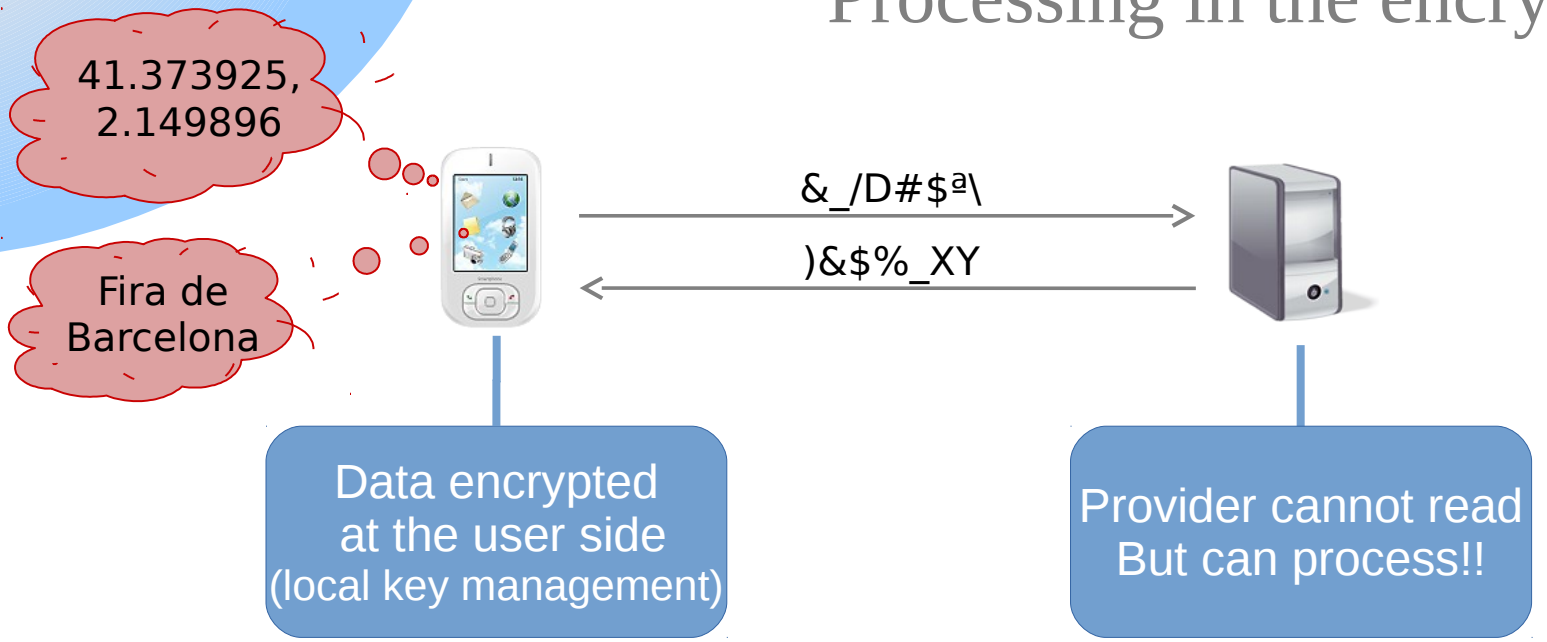

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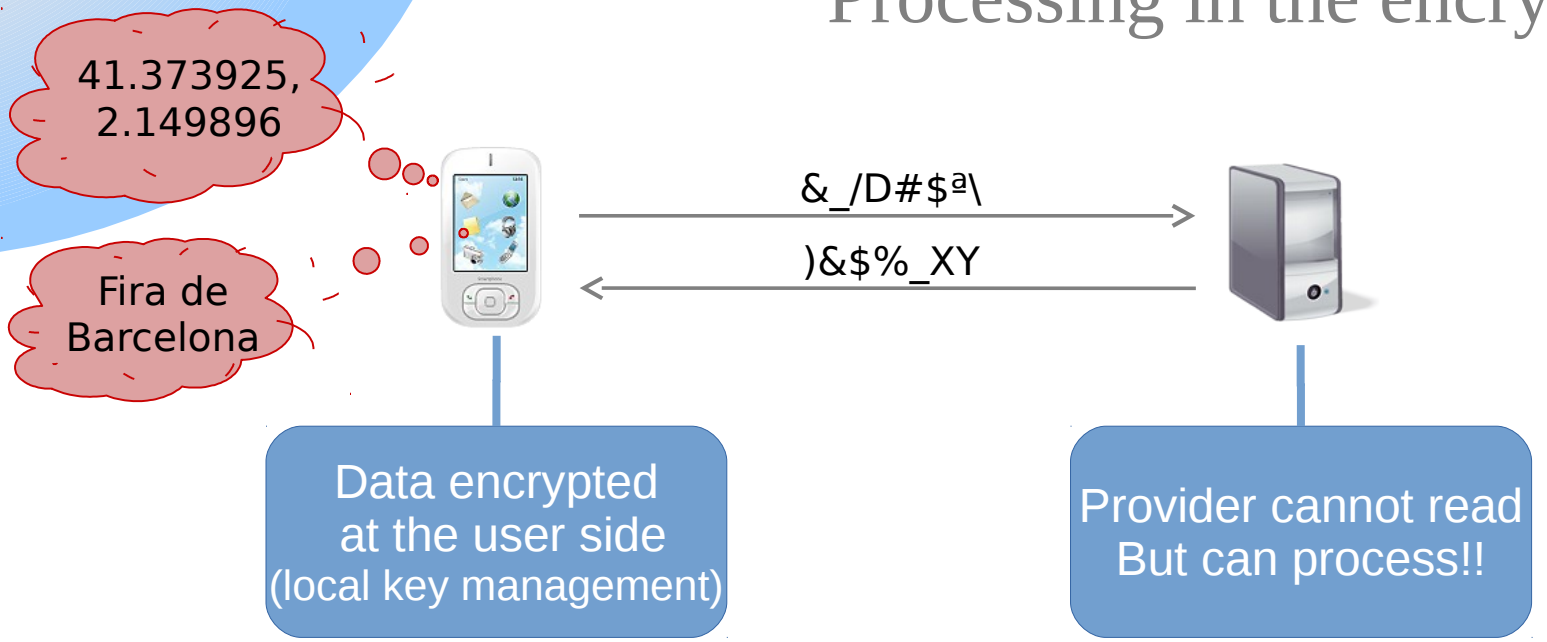

Best of both worlds: service AND privacy!

Advanced cryptography
Processing in the encrypted domain

What “magic”is possible?

- Private searches
- Private billing
- Private comparison
- Private sharing
- Private statistics computation

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No personal data involved: is a reality!

Personal data: not yet guaranteed, but there is a path!

- Anonymization and privacy evaluation
- Advanced cryptography

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We need to work together to walk this path!

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