

# A Study on The Value of Location Privacy

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## Starting Points

- Privacy intrusive technologies become more common
  - GSM system used for tracking down particular handsets (more precise than needed for the GSM system itself)
- What is the value of privacy?
  - How much are people willing to pay to protect their privacy (location privacy in this case)
  - What are black market prices and penalties
    - UK: £17.50 for address; up to £500 for criminal records check; £750 for mobile phone account details. (UK IPC, May 2006)
    - UK – penalties for privacy breaches in low £'000 per individual
    - US health data (HIPAA) – civil penalty \$100 per violation
- Design a study about how much people want to get for being tracked 24/7

## Grounds of the Experiment

- 2005 Cambridge University Study
  - *How Much is Location Privacy Worth (WEIS 2005)*
  - Same goal: money people ask for being tracked by mobiles
  - Subjects were students in the Computer Lab
    - about 75 students, homogenous population, identifiable
- Monetary compensation but our budget is limited
  - what's your bid to take part
- The cover-story
  - Study about mobility of people to assess appropriateness of the mobile networks' topologies
  - Scanning every 5 minutes, 24x7 for 30 days
  - Academic research, no commercial exploitation of the raw data
  - Position resolution 800m in rural areas / 100-200m in towns

## New Study

- Organised within FIDIS project ([www.fidis.net](http://www.fidis.net))
  - Spring 2006
  - Pseudonymity, with only email address provided
- Five countries involved
  - Belgium, Czech Republic, Germany, Greece, Slovakia
- Information advertised to
  - University students (IT) – all countries
  - University students (regardless on study) – CZ, DE, SK
  - Mobile phone community – CZ, DE

## Structure of the Implementation

- First form (webpage)
  - Language
  - Background (computers, law, other)
  - Gender
  - Network operator used (list of local operators)
  - Do you carry your mobile all the time?
  - How often are irregular movements (hourly, daily, weekly, monthly)?
  - Who do you talk to (friends, family, partner, business)?
- Second form
  - Commercial exploitation (decline, same bid, revised bid)
- Third form
  - Commercial use for one year (decline, write the bid)

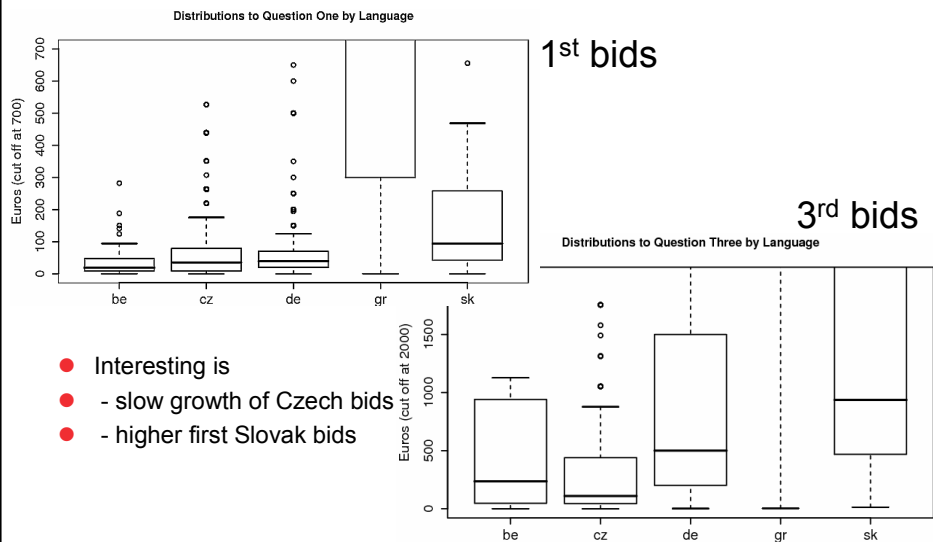
## Demographics

- Number of participants per country
  - Belgium 37/3 (# of participants/females)
  - Czech Republic 744/131
  - Germany 251/33
  - Greece 30/6
  - Slovak Republic 152/46
- Students in all countries, mobile phone communities in Czech Republic and Germany
- Size of sample sets
  - Czech Republic, Germany, Slovak Republic – detailed analyses
  - Belgium, Greece – too small, control sets

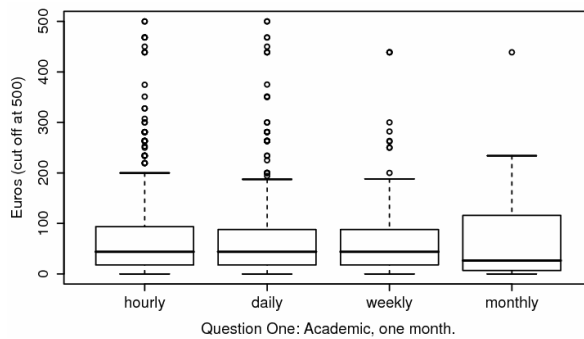
## Cautiousness

- Drop-out rates
  - Early drop-outs (239 out of 2582)
    - BE 12 % CZ 6 % DE 12 % GR 25 % SK 12 %
  - Standard drop-outs
    - BE 56 % CZ 44 % DE 48 % GR 68 % SK 58 %
- Not interested
  - Greeks stand out, unfortunately the sample set too small
  - There is a remarkable number of really high bids
    - creating “linearity” from “not interested” to average bid

## Differences among Countries

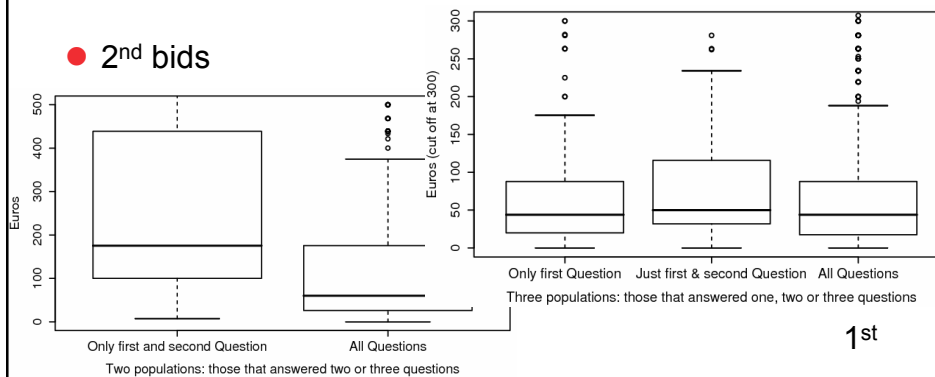


## Mobility



- Sizes of sample sets: daily 520, hourly 485, weekly 195, monthly 15
- Expectation was that there is correlation between values and irregular movements

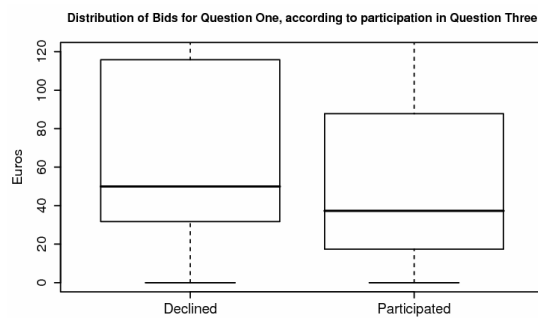
## Impact of scenarios



- 2<sup>nd</sup> bids
- Curiosity vs privacy cautiousness
  - Left – low bids: curiosity and falling off in the second round
  - Middle – higher bids, increased in the second round
  - Right – low first bid increased in each consecutive round

## Impact of Scenarios II

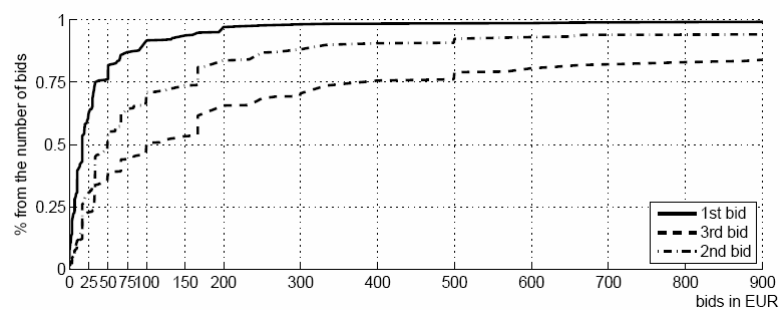
- Medians of the first bids according to answers in the second round (decline, same, revise) are all the same – 47 EUR
- Bids according to answers in the third round (declined, participated)



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## Overall distribution of bids



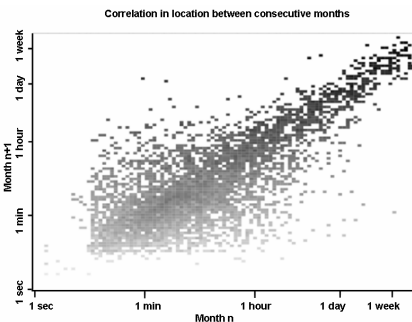
- Second bids (2.5x first bids)
- Third bids (2x second bids)

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## Non-linearity in time

- 12-fold increase in the experiment length
  - 2x increase of the bids
- Hypothesis
  - Data after the 1<sup>st</sup> month are of less value
  - Little information in consecutive data
- Correlation between consecutive months (MIT Reality Mining project)



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## Why Participating in The Study

- Questioned after the experiment
  - 300 responses (25 % of the participants)
- Why did you take part in the experiment
  - Money (38 %), results (32 %), fun (30 %)
- Correlated bid values (medians)
  - 1<sup>st</sup> auction: 12, 8, 9 (roughly)
  - 2<sup>nd</sup> auction: 9, 5, 6 (roughly)
  - No substantial difference between bids

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## Conclusions

- 10 % of participants bidding < €1
  - Curiosity and enthusiasm for cover story
- Greek sensitivity to privacy breaches
  - Eavesdropping scandal a couple of months before
- Non-linearity in regard of the study length
- No correlation between bids and movements
- Insignificant difference between sexes
  - the 2<sup>nd</sup> and 3<sup>rd</sup> bids 1.4 : 1 (F : M)
- Medians of Cambridge study correspond to our results (€43 to £28)

**Your turn ...**