

## **SS7Tracker - Active GSM Cell-ID Tracking** *Where did you disappear?*

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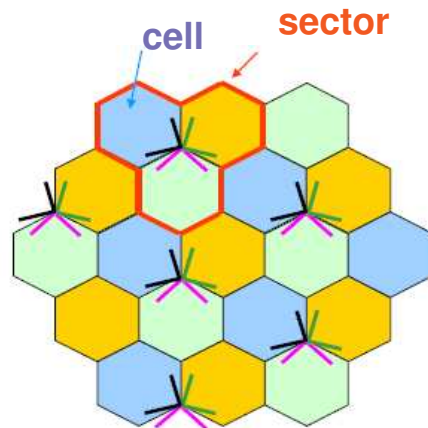
Prague, Czech Republic

# Outline

- Motivation – WHY??
- Solution – HOW?
- Results – WOW!
- Discussion
- Future – NOW!

# Project motivation

- GSM network
  - cellular network
  - signal coverage
  - signal strength

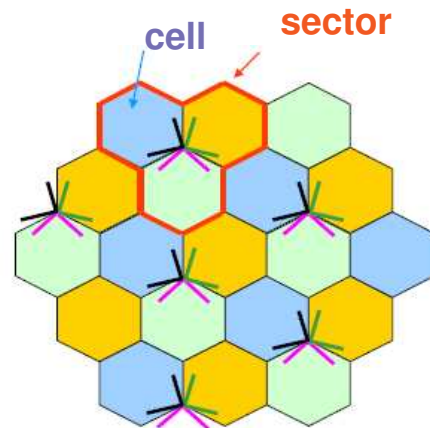


- Roaming
  - 17% mobile revenues globally
  - United States only 3%

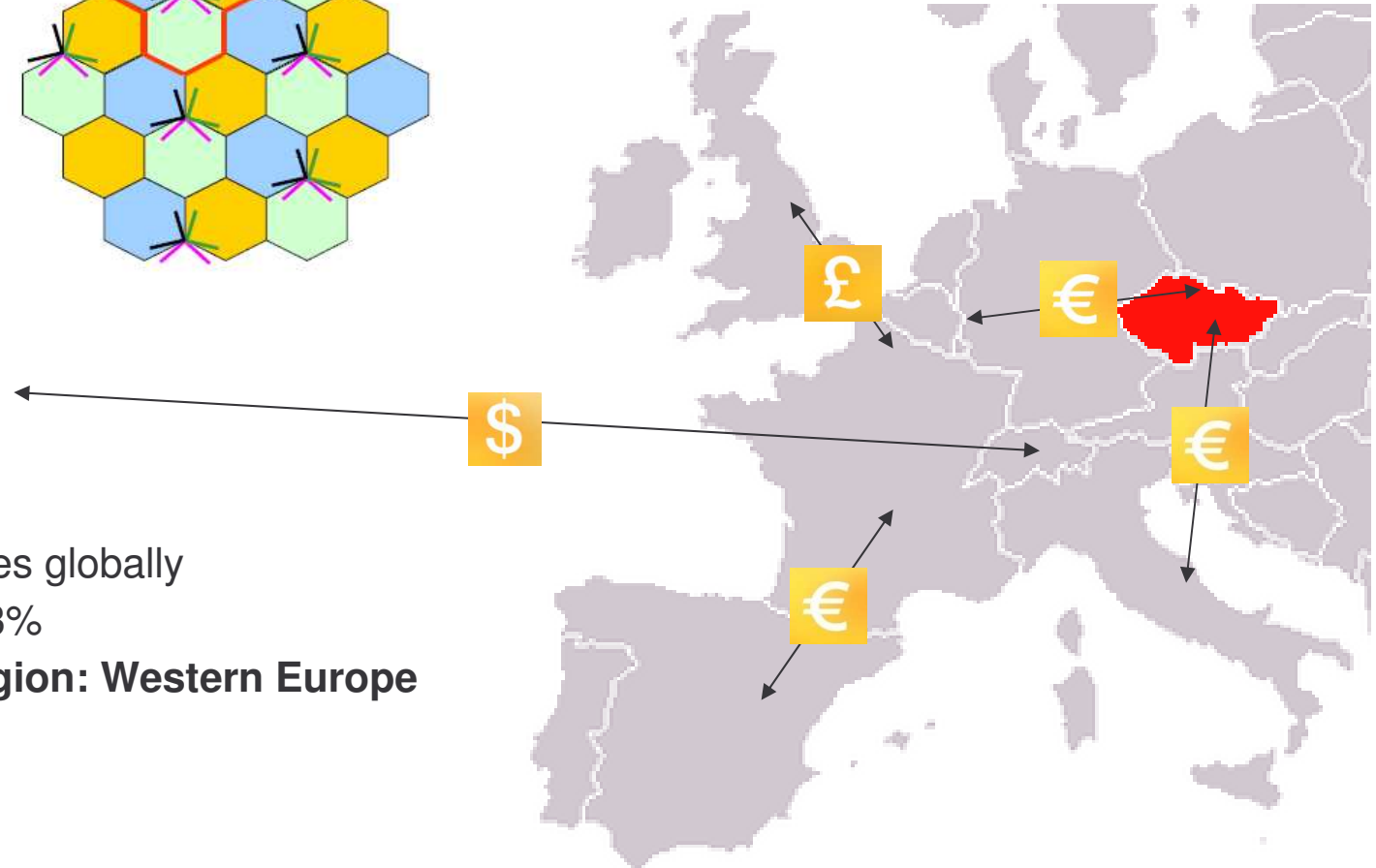


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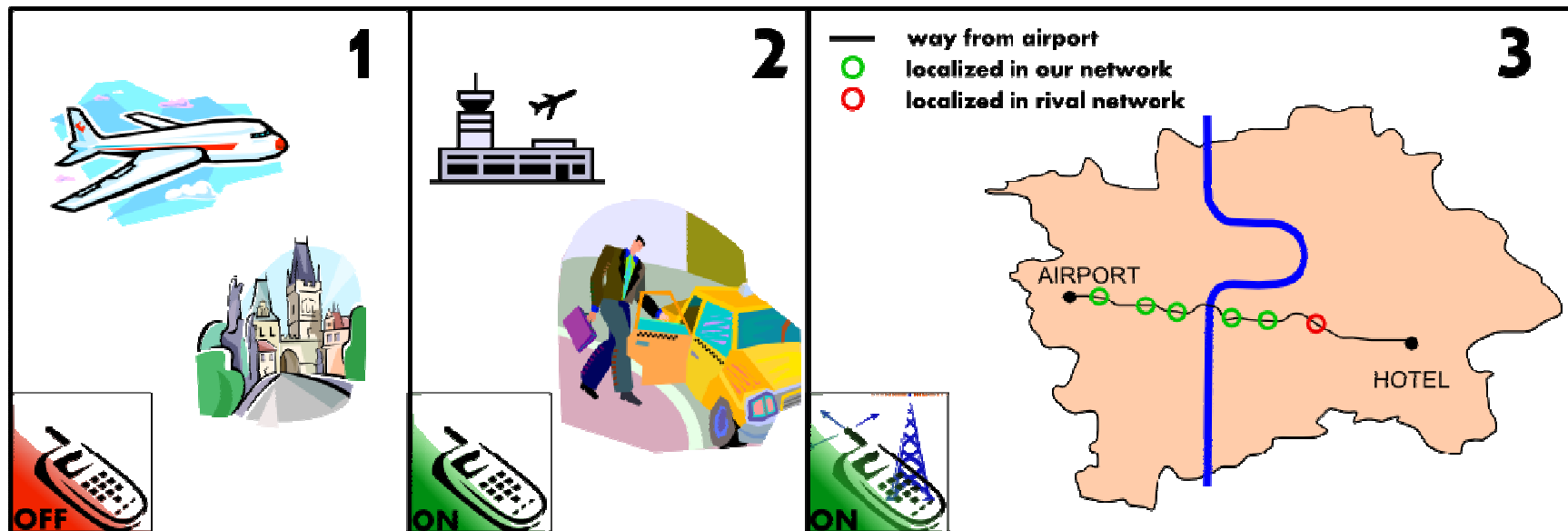


- Roaming
  - 17% mobile revenues globally
  - United States only 3%
  - **most important region: Western Europe**

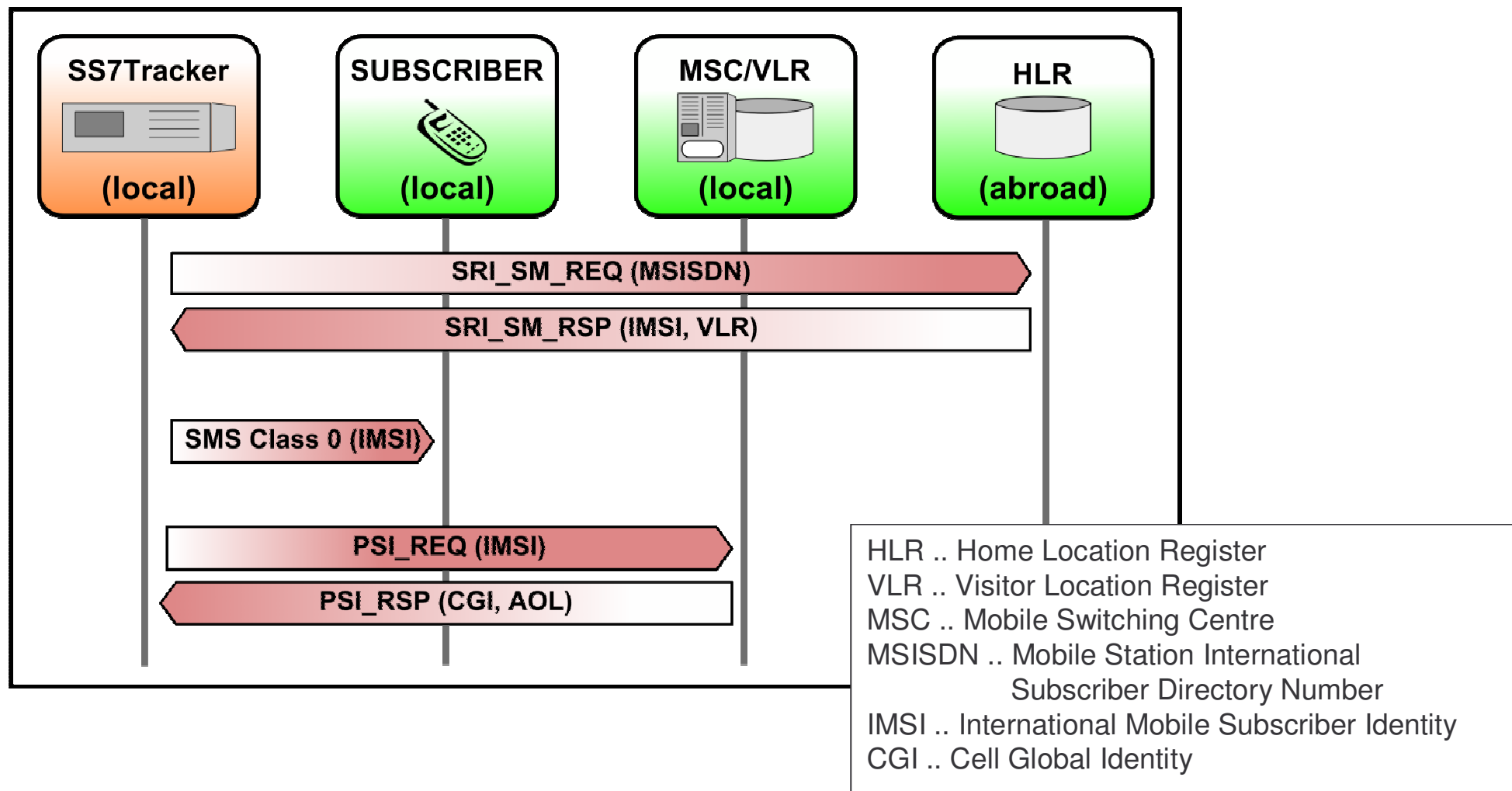


# Goal: Discover mobile network coverage weak points using inroamer active tracking

- Inroamers are foreign roaming clients subscribed to the studied network
  - can switch GSM network freely!
- Active tracking relies on sending extra queries to the network
- Typical scenario



## Message flow

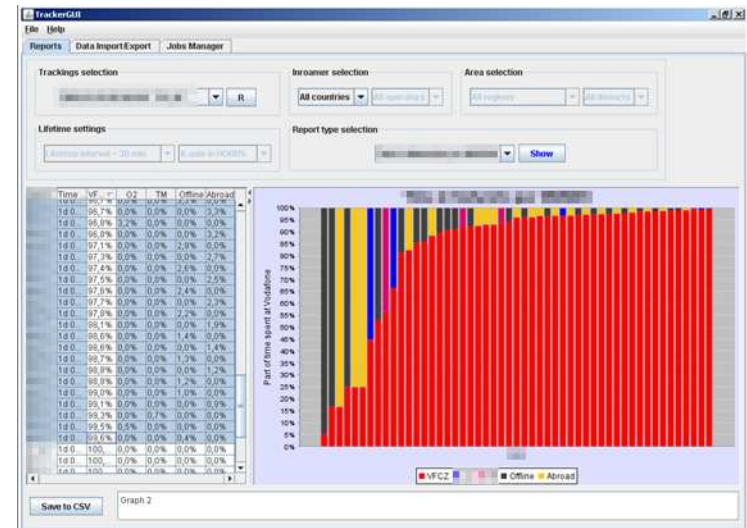


# Solution architecture

- Server – SS7Box
  - SS7Box located in RDC
  - Equiped with signalling card
  - Connected to **live** VF CZ network
- Client – TrackerGUI
  - Tracked data statistics in graphs
  - Tracking scenarios definition
- Technology
  - Signaling System No.7 (SS7)
  - Hidden-SMS-based solution

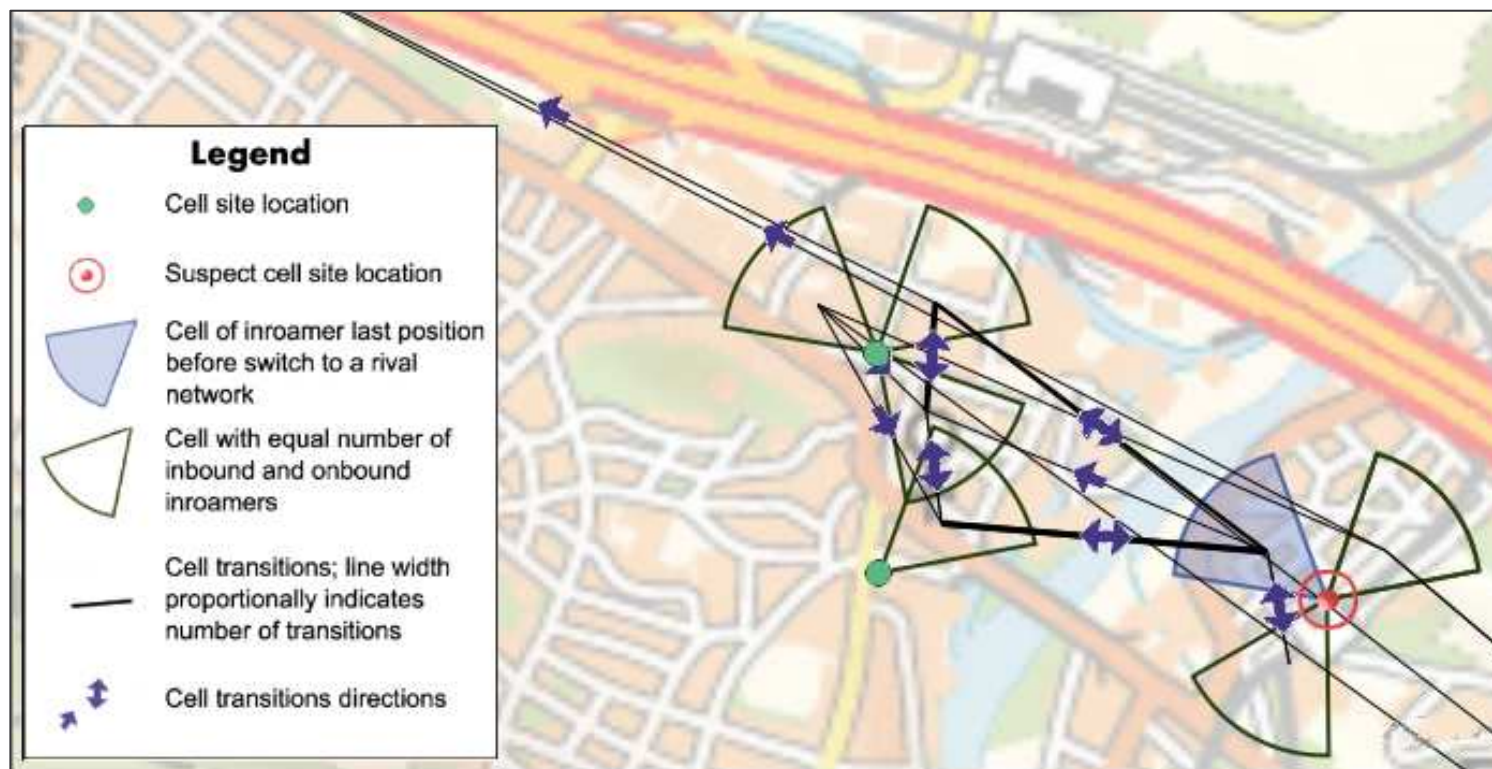


Dialogic SPCI4 card



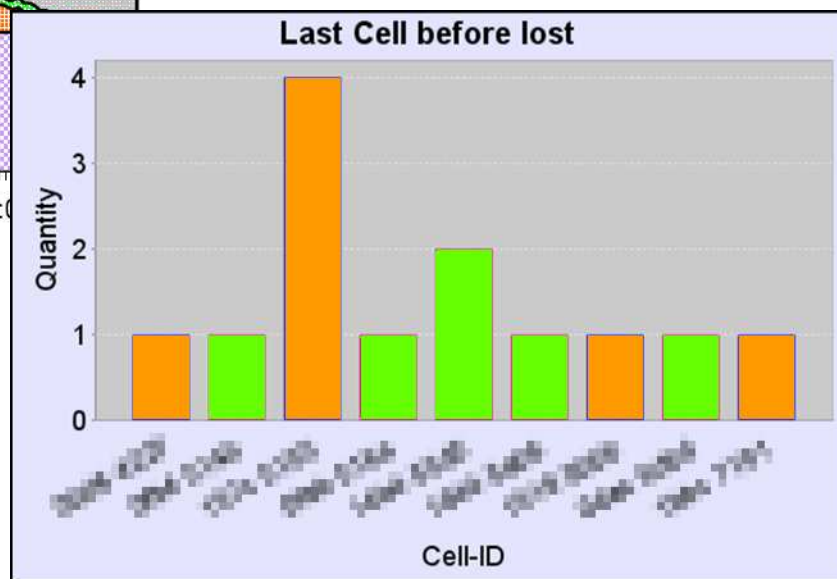
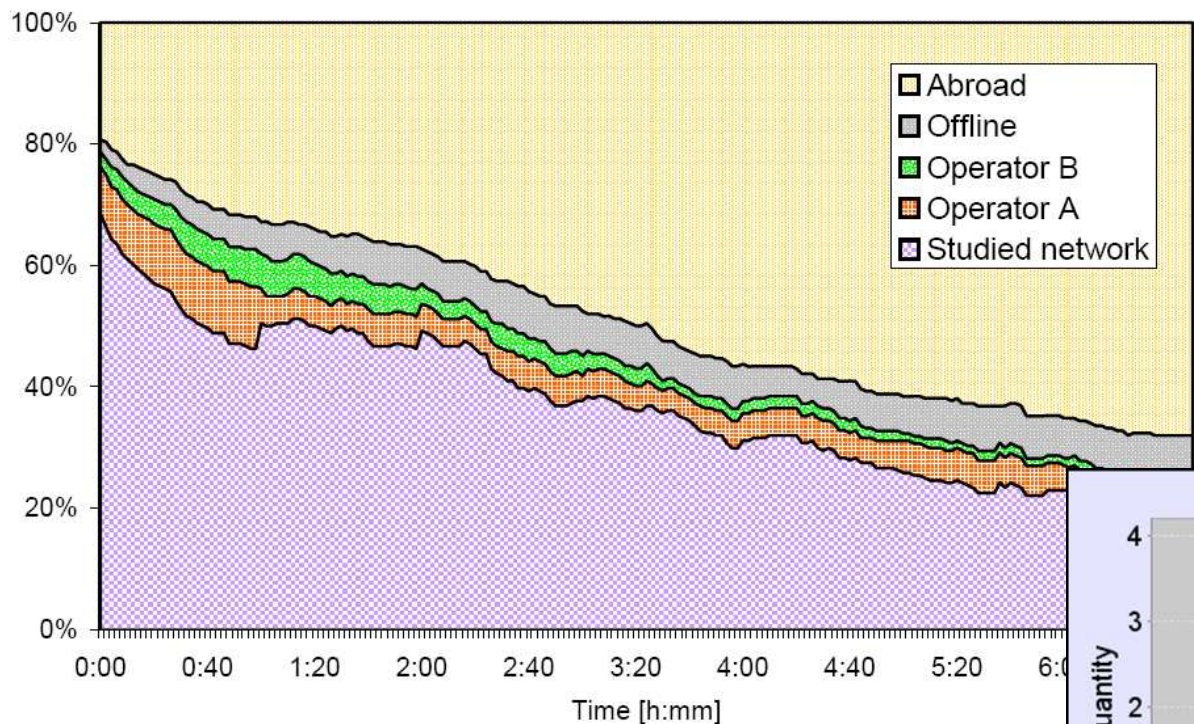
TrackerGUI client application

## Results: Tracked and visualized data from real inroamers



- Experiment:
  - 105 inroamers
  - During 6 hours
- **Outcome: List of suspicious cells**

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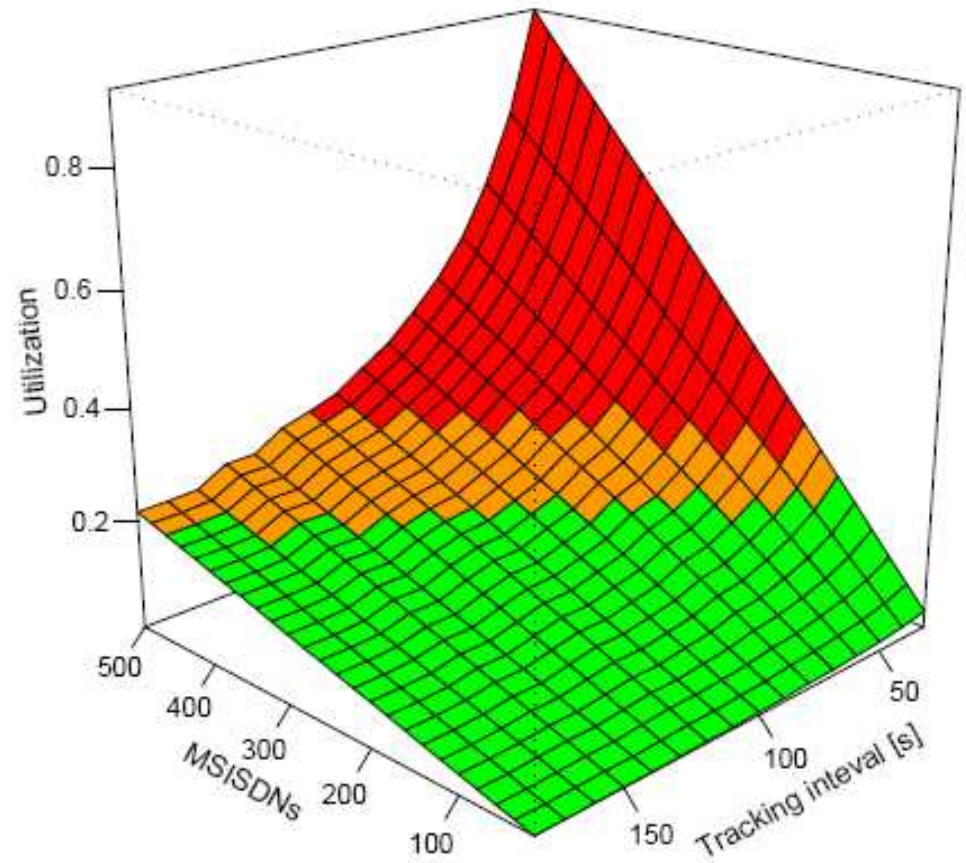
# SS7Tracker Features

Location Server tracking a mobile unit to Cell ID precision in real time

- non-disruptive - requires no change to infrastructure (plug & play)
- can track a passive mobile station
- real-time
- configurable
- tried and tested in Vodafone CZ (in-roamer tracking)

## Discussion: Capacity

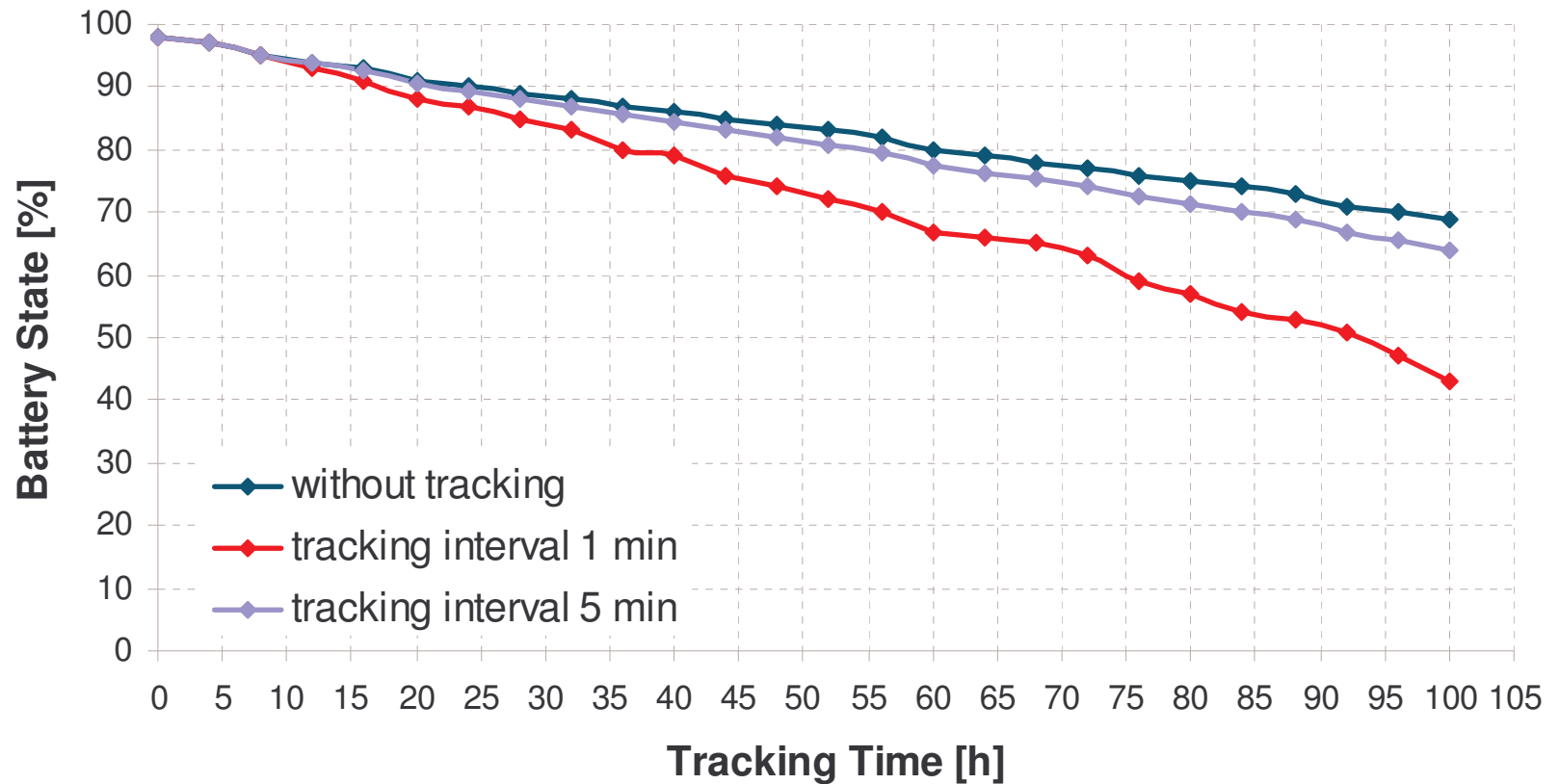
- SMS-based solution may overwhelm network if many customers
  - signalling line utilization using discrete simulation
  - local site overload



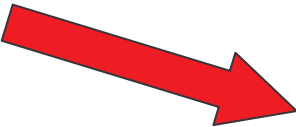
# Discussion: Battery lifetime

– may affect battery

SonyEricsson K750i

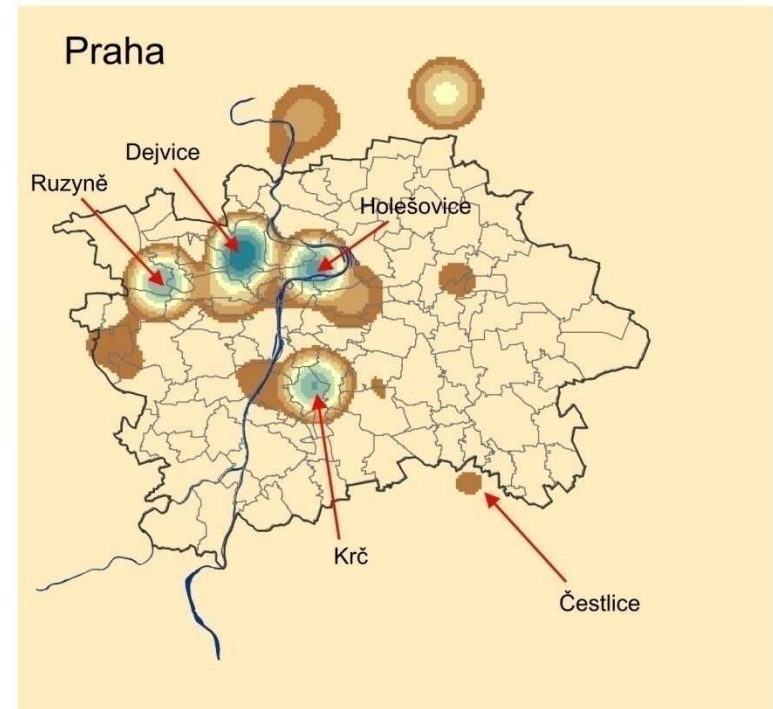


## Discussion: Accuracy

- GSM based solution – Cell-Id accuracy
    - + availability
    - + works in every GSM network
    - + no additional changes into network nor mobile stations (lowcost)
    - + work with every mobile station HW (which supports SMS)
    - accuracy
  - GPS
    - + accuracy
    - need of special equipment
    - not reachable everywhere
-  not really disadvantage!

# Parallel Ongoing Activity: Location Data Mining

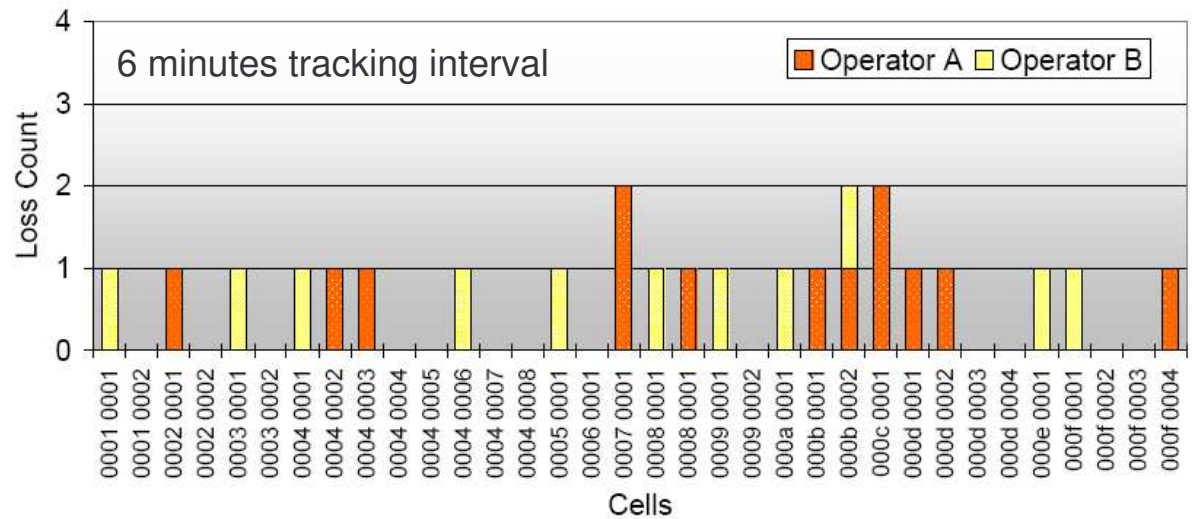
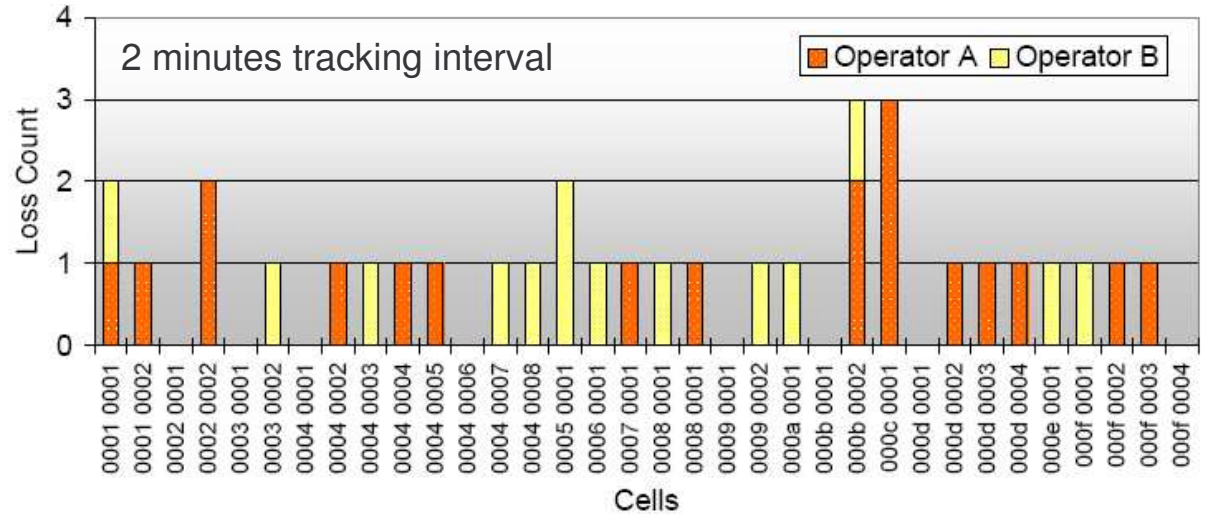
- Statistical evaluation and extended visualization of tracked data
  - cooperation with Faculty of Science, Charles University, Prague
- Focused on
  - Urban dynamics in real-time
  - Fluctuation of traffic density by seasons, weeks and hours
  - Space-time behavior studies
- Commercialization?
  - Customer behavior analysis
  - Targeted advertising



Urban dynamics of inroamers in Prague

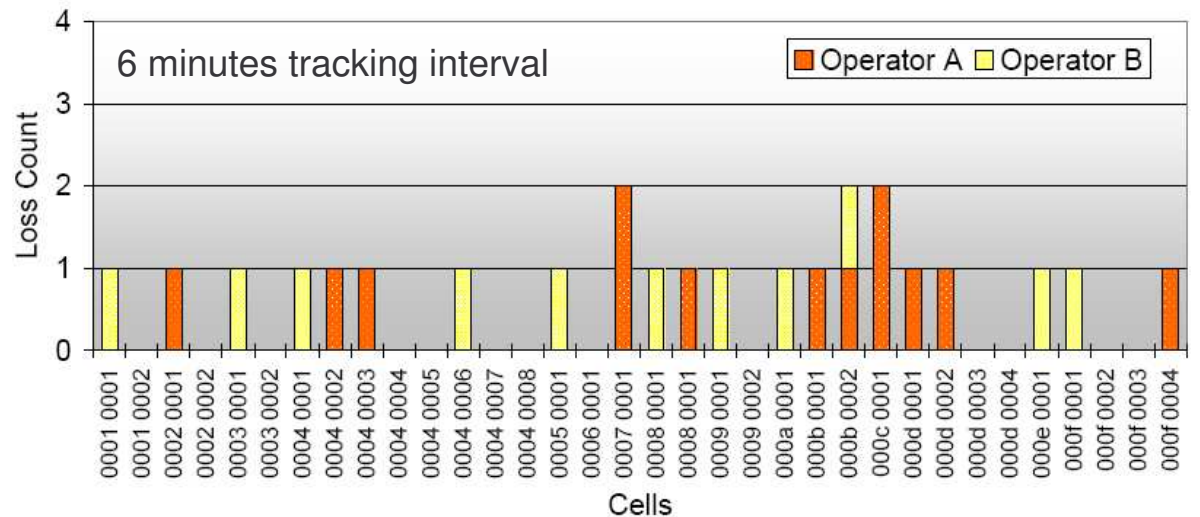
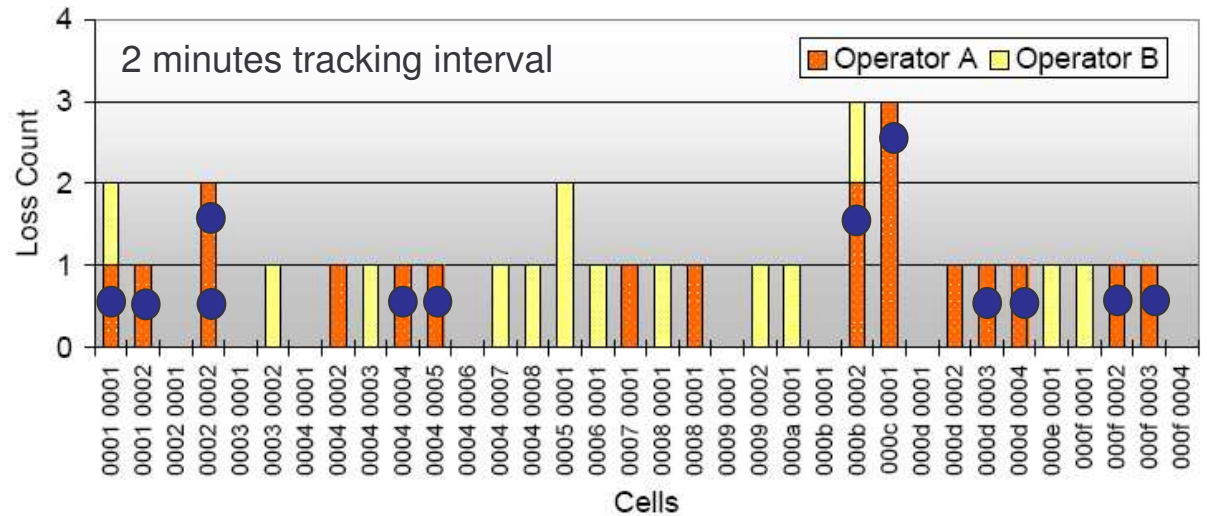
# Future of SS7Tracker

- Network migration analysis
  - how often?
  - why?
  - especially in Europe
- Math & Modeling
  - handover between cells
  - handover effectivity
- Tracking parameters tuning



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# Conclusion

- **Demonstrated Cell-ID based location tracking usefulness**
- **Opens promising areas for further research**

# Thank you!

- Interested?

- Ask questions
  - Read our article
  - Think about it
- } order does not matter


- *Katerina Dufkova, Michal Ficek, Lukas Kencl, Jakub Novak, Jan Kouba, Ivan Gregor, Jiri Danihelka, **Active GSM Cell-ID Tracking: "Where Did You Disappear?"**, Mobile Entity Location and Tracking Workshop at ACM Mobicom 2008, San Francisco.*

R&D Centre for Mobile Applications (RDC)

[www.rdc.cz](http://www.rdc.cz)

# Discussion: Privacy

- Country legal system
  - Czech Republic
  - EU directive

 legal for network optimization and scientific purposes
- Data in operators security perimeter
  - another view of information already managed
- Reports design
  - only aggregate data with no relation to individuals