Predicting parking occupancy in a sensor-enabled smart city

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Innovation that works

About Mobics

- Founded in 2006 as a University of Athens Spin-off (Dept. of Informatics and Telecommunications)
- Mobics is a research-intensive SME with a goal to develop and commercialize science-based innovations in the ICT domain
  - E.g., machine vision for crisis management and sports, sensor information fusion for smart infrastructures
- Quite active in national and EU R&D projects

SmartSantander: a large smart city testbed

- A FIRE project that ended with “excellent progress” (as assessed by the EC) in 2013
- IoT testbeds in 4 sites, with Santander (Spain) being the largest
  - ~20.000 connected sensors of various types
  - ~350 on-street parking sensors
- Main development: a middleware layer that enables experimentation and further development of end-user services
- Mobics joined that project through an Open Call for experiments
  - Deployed mobile and Web ITS applications for the citizens with an emphasis on parking occupancy prediction

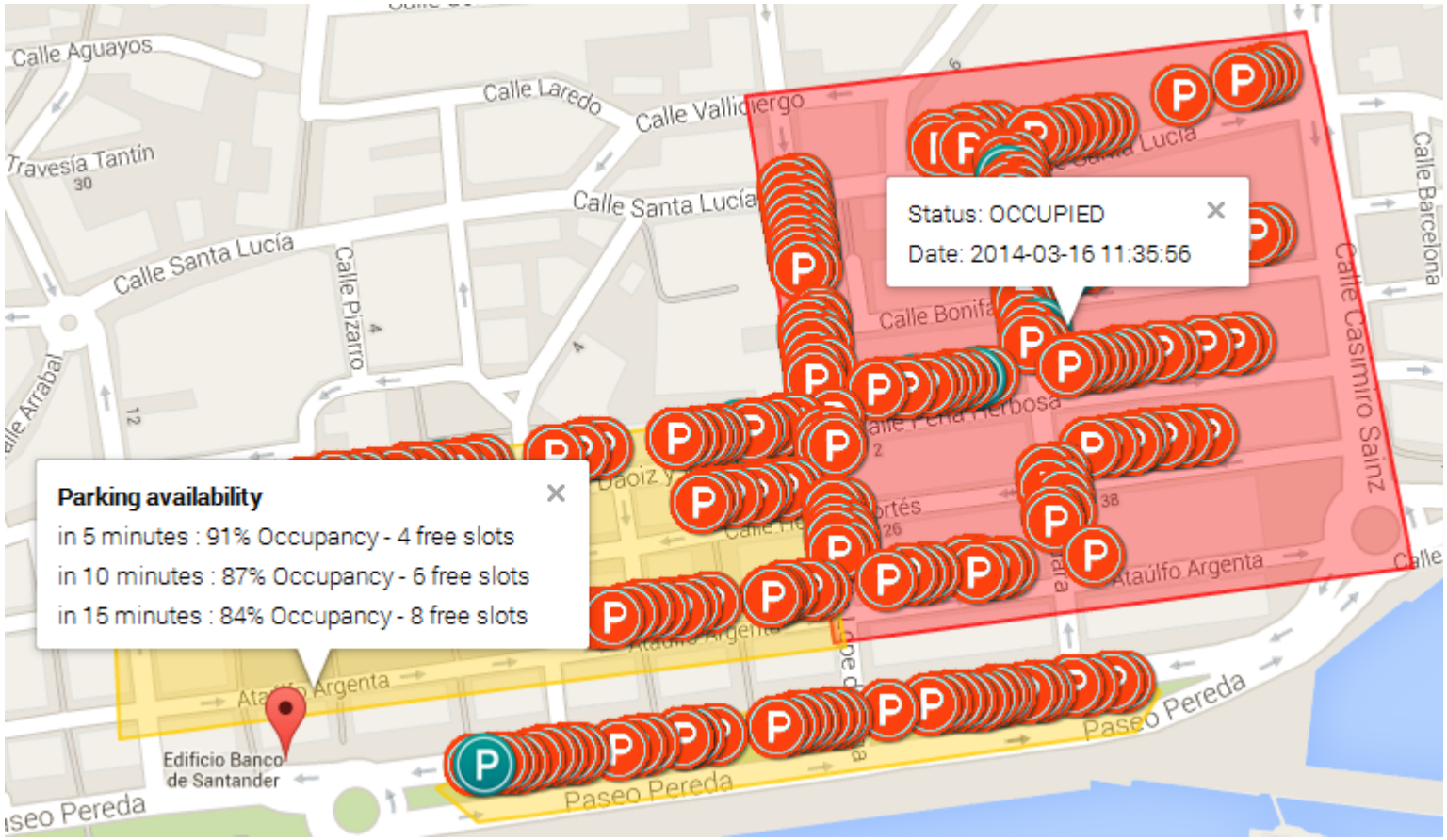
Predicting parking occupancy

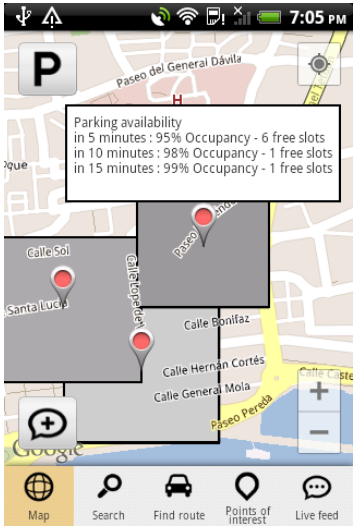
- Wireless parking sensors were installed in some city blocks



- Mobics team (including NTUA transportation researchers):
  - performed segmentation of the monitored parking areas
  - collected **a massive amount of real-world data** through SmartSantander middleware
    - Readings every 1 minute during the 6 months of the experiment
  - used part of them as a training dataset to train a neural network
  - evaluated the prediction accuracy of the model with the collected data
  - visualized the results through Web and mobile applications

What the user sees





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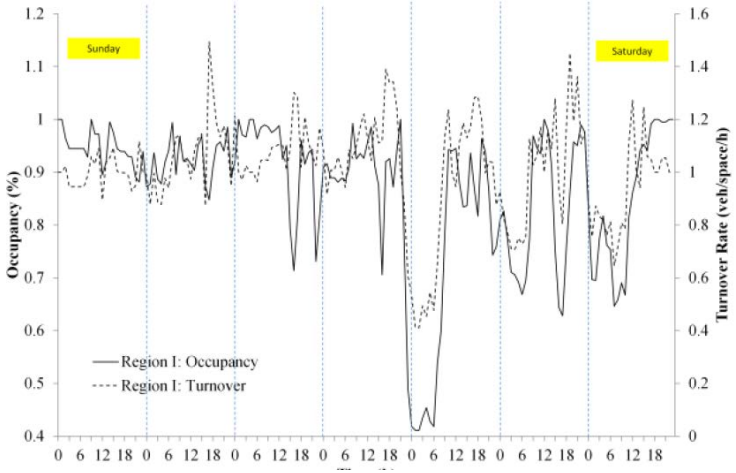

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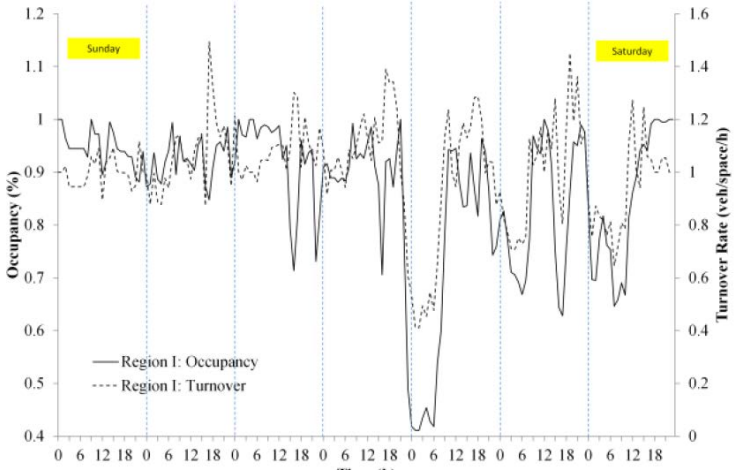

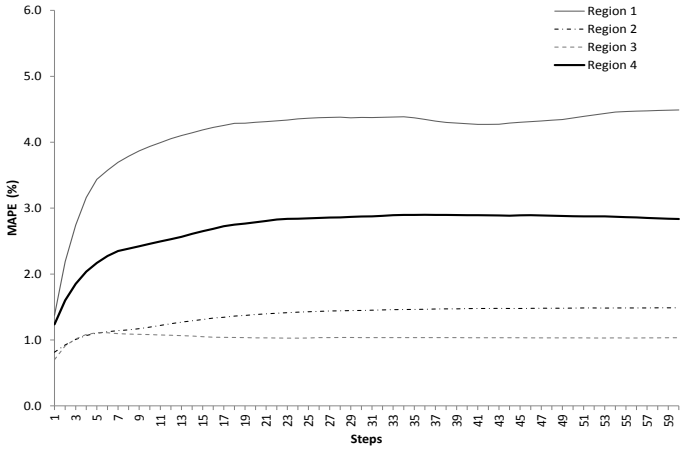

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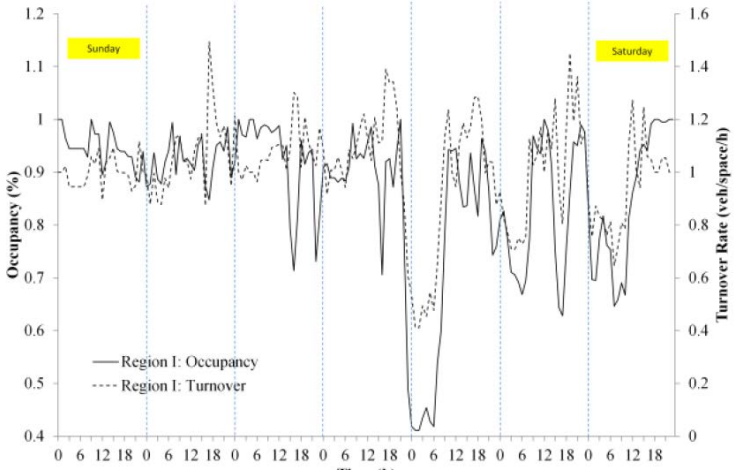

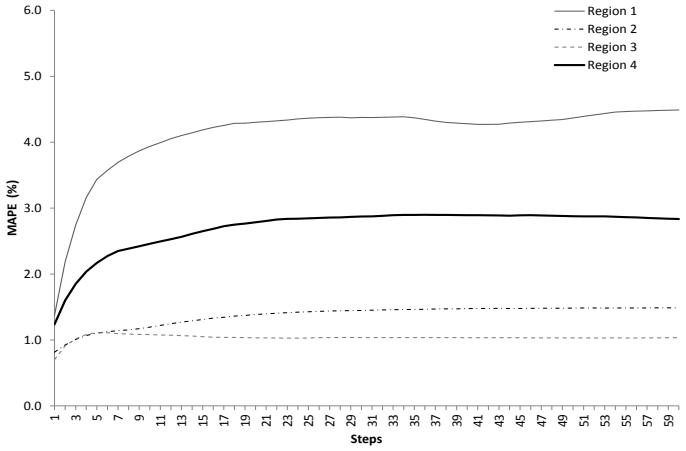

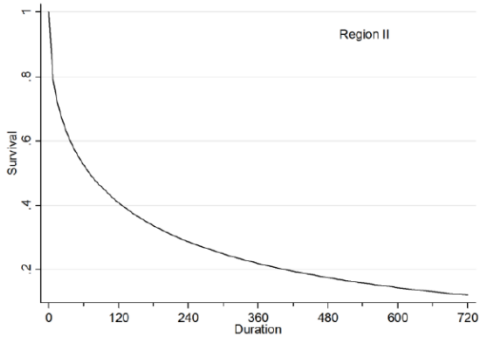

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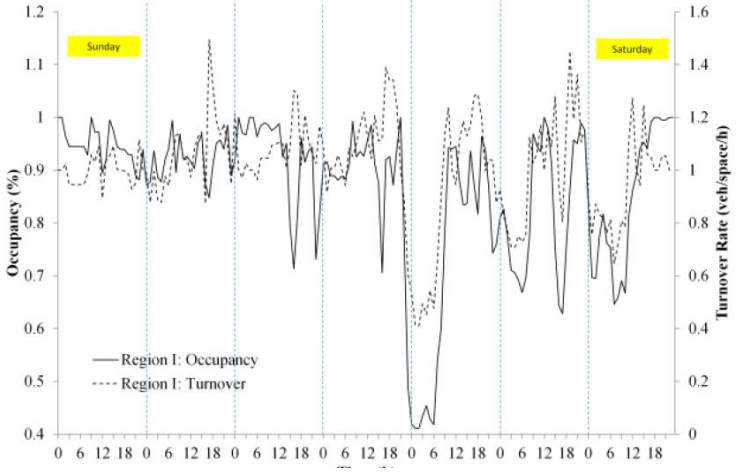

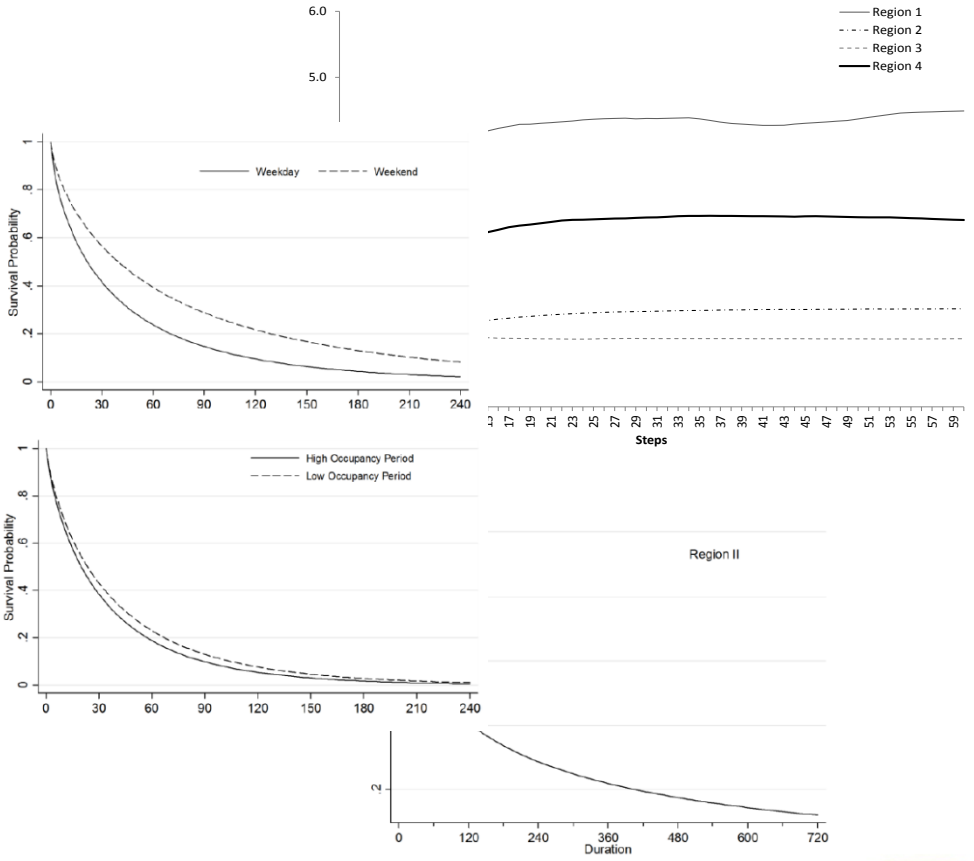

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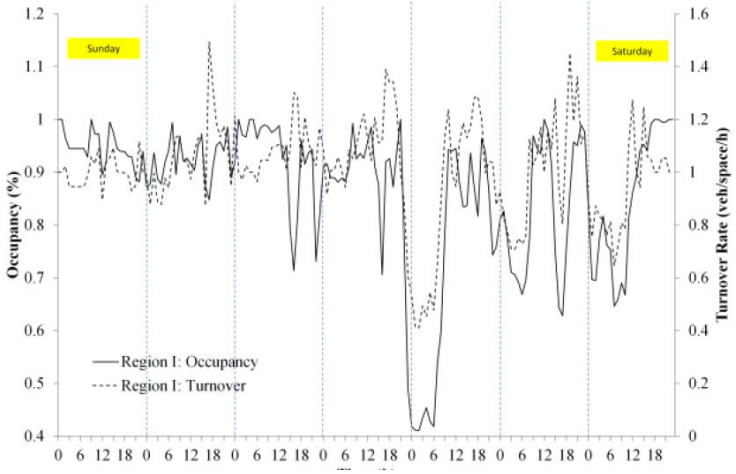

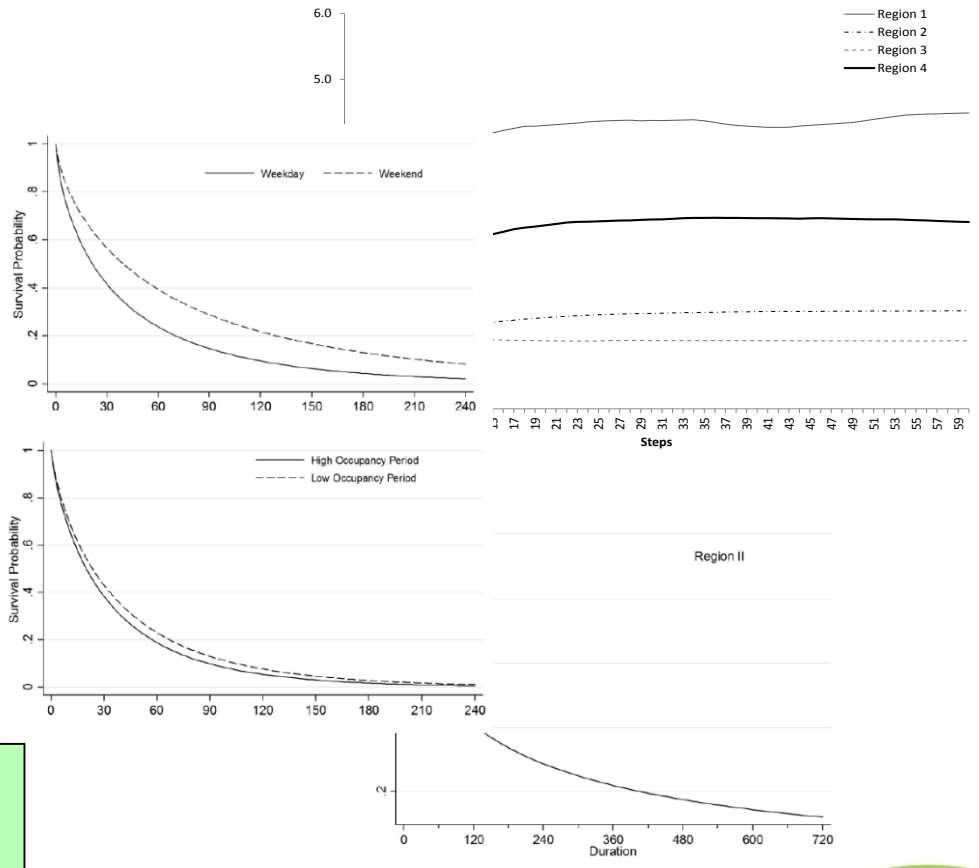

***"All regions**: differences in the mean occupancy and turnover rate between weekdays and weekends"*

Our overall experience

- Easily accessible data through the developed middleware
- Verification of faults in sensor values was hard
- Several performance problems were identified in our system, due to the big amount of data
- We could not afford the cost for such experimentation by ourselves
  - We would probably abandon the idea, given the research nature of the application and its unknown market potential

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The added business value

- We were able to validate new algorithms and applications with real data
- We came up with a new service offering
  - Integration of parking prediction to multi-modal route planning (car + public means)
  - *“Locate the best available parking area in the city center perimeter, from which you can easily reach your destination by public transport”*
- In contact with sensor technology vendors to investigate joint exploitation

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Final remarks

- We have two more algorithms that we cannot test adequately due to lack of open data
  - Fault diagnosis for smart infrastructures (ships)
  - Proactive re-routing of public transport commuters based on bus locations and delays
- Open data can help SMEs to:
  - rapidly prototype and decide on the potential of new ventures
  - validate novel algorithms & services (quality check)
  - stress test their systems (performance check)
  - get a first “client” reference and marketing material
- *The ideas are out there… let the data join them!*

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Thank you for your attention!

Users not interested in our system… they will park anyway!

Vassileios Tsetsos

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