Understanding urban dynamics from digital traces

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Context

50% of the globe's population live in urban areas (just 0.4% of the Earth's surface)
70% are projected to do so by 2050

The greatest wave of urbanization is yet to come

- Great opportunity for improving people life stiles
- A potential economic, health and environmental disaster

Transportation

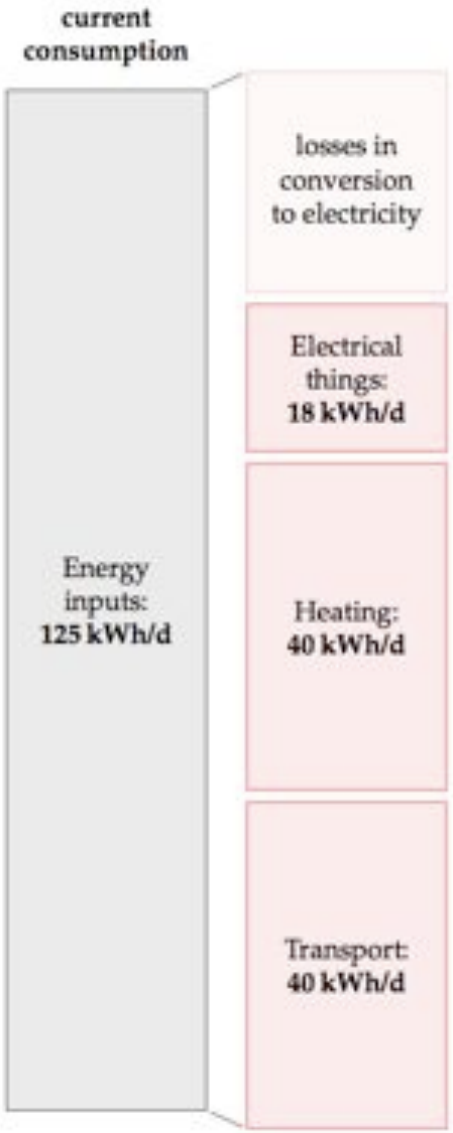
Transportation currently accounts for **one third** of the nation's energy use

Personal mobility consumes about **two thirds** of the total transportation energy use

Given increasing concerns with energy demand and environmental sustainability, urban transportation faces a **grand challenge** of:

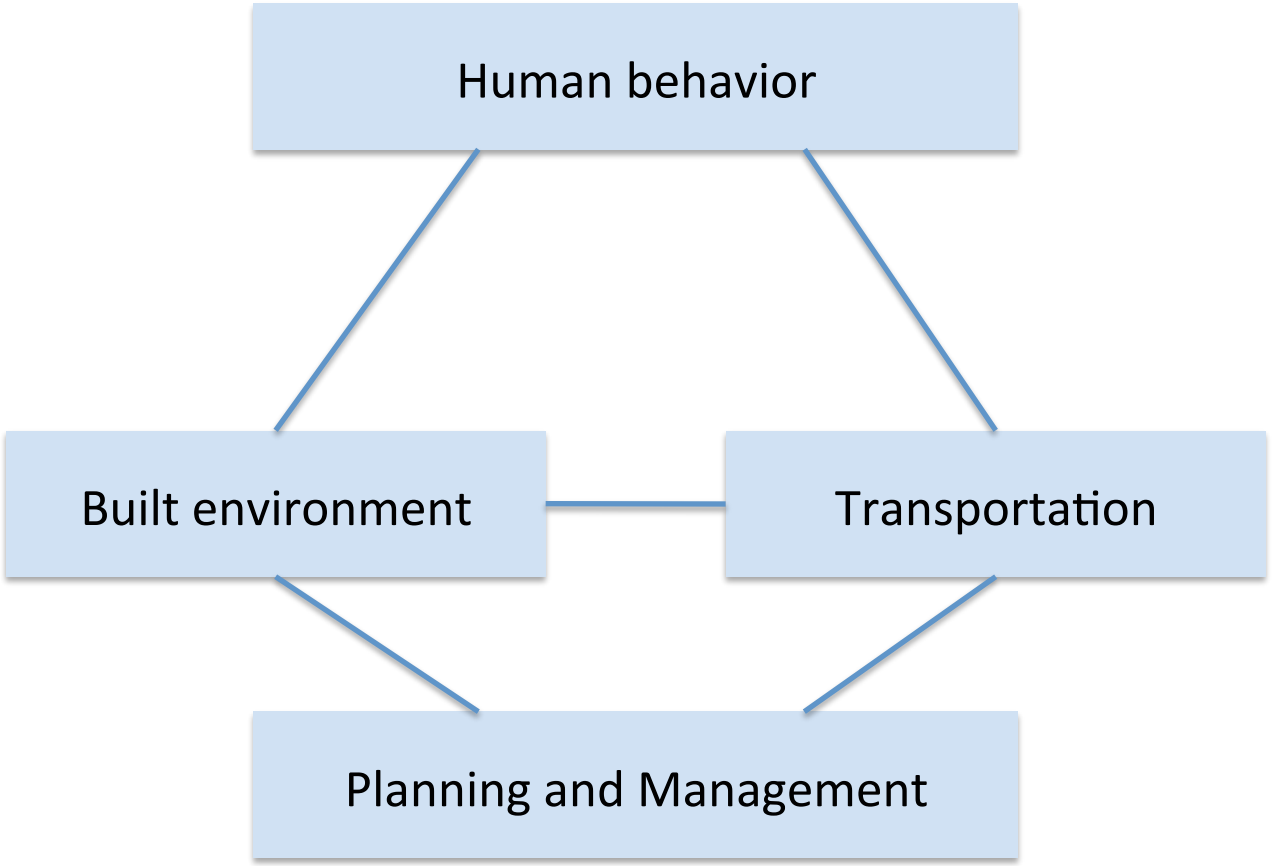
providing access to goods, services and opportunities necessary to enable human development while preserving the environment.

C. Barnhart Transportation @ MIT initiative, 2009

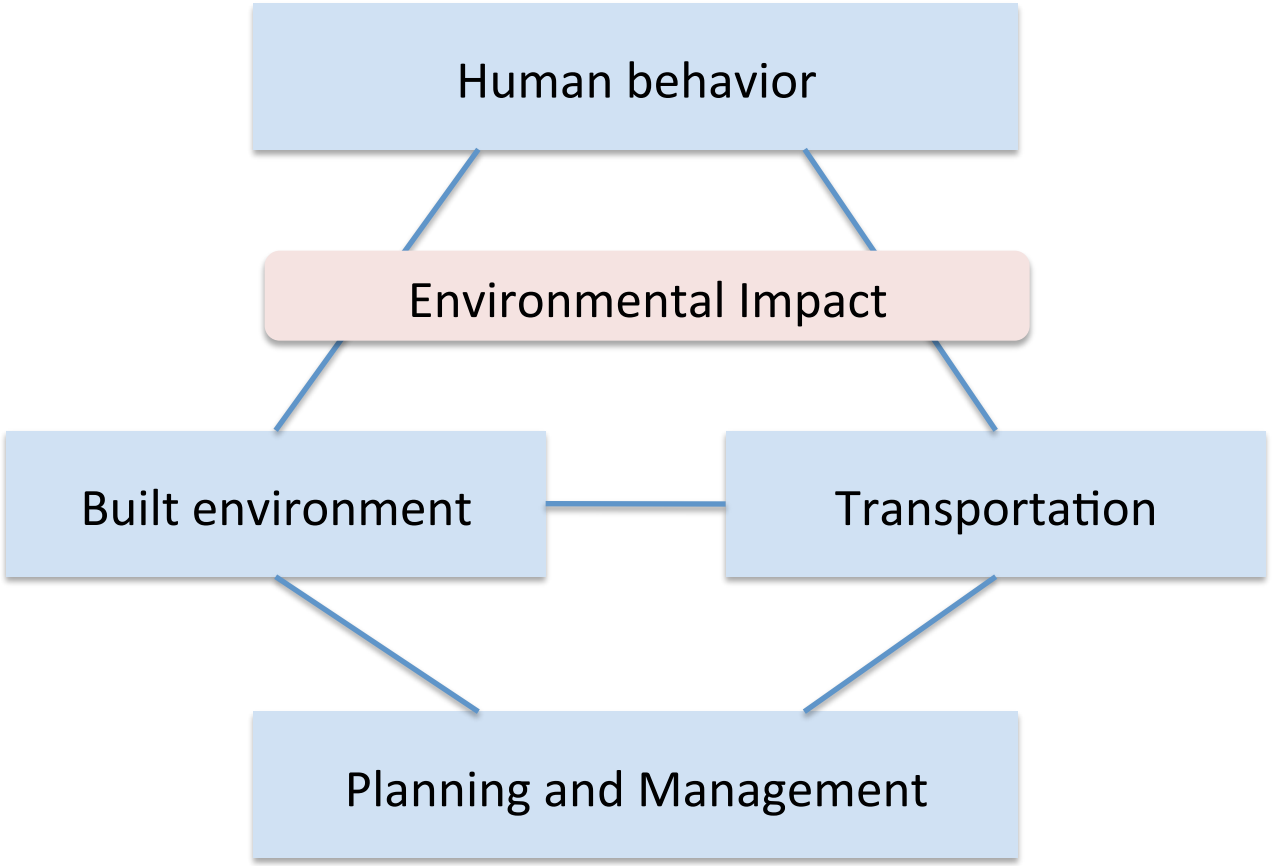


David MacKay, Sustainable Energy - without the hot air, UIT , 2009

Framework


Human behavior
Built environment
Transportation
Planning and Management

Framework


Human behavior
Environmental Impact
Built environment
Transportation
Planning and Management

My research

Designing and evaluating the impact of intelligent transportation systems in reducing transport demand in cities:

- Understanding human behavior in terms of mobility demand
- Analyzing and predicting transportation needs in short and long terms

Applications

- More efficient planning
- More efficient transportation management

Pervasive technologies datasets

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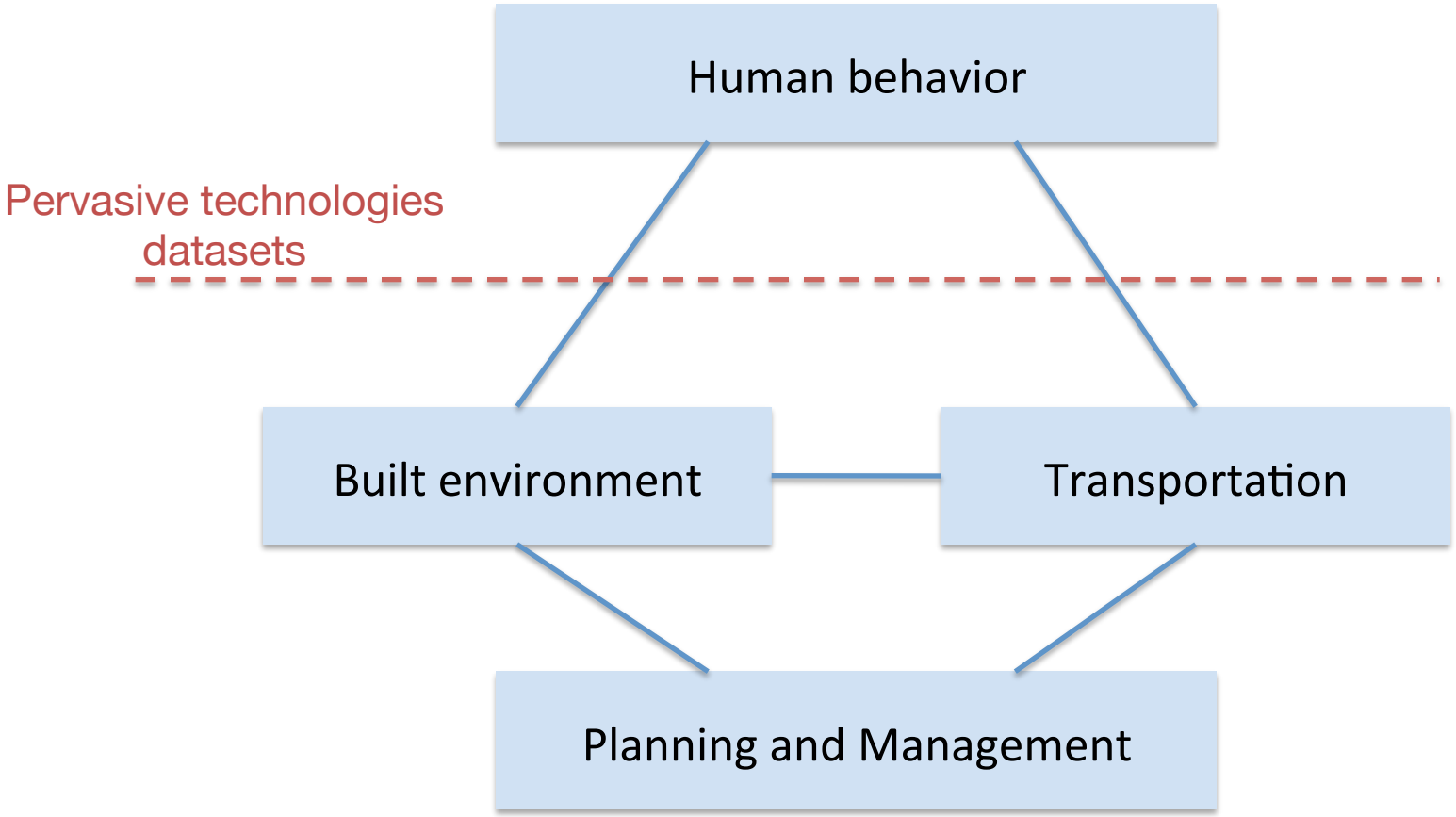
Potentials

- possibility to study micro and macro behaviors
- data is becoming more and more available (mobile technologies increasingly adopted by the population)

Privacy concerns in the use of personal data only partially addressed by the EC (*)

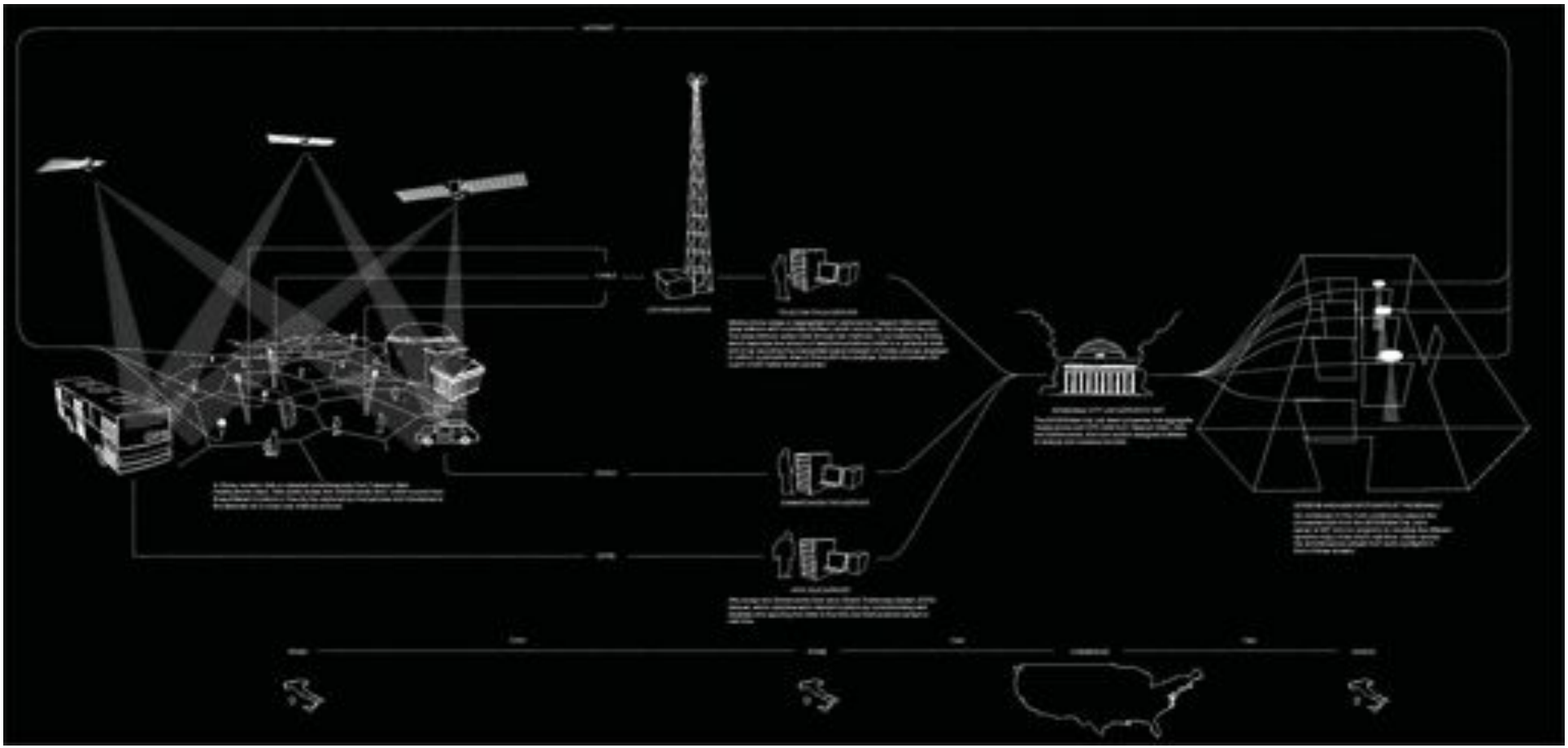
(*) Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communication sector (Directive on privacy and electronic communications)

Cyber-physical system



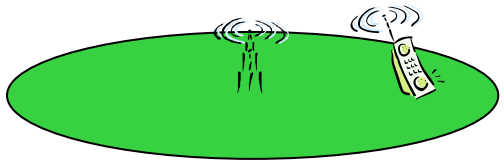
Real time data collection

Goal: Extract individual mobility information from telecommunications and transportation networks

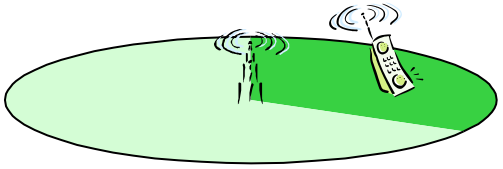


F. Calabrese, M. Colonna, P. Lovisolo, D. Parata, C. Ratti, Real-Time Urban Monitoring Using Cell Phones: a Case Study in Rome, IEEE Transactions on Intelligent Transportation Systems, 2010.

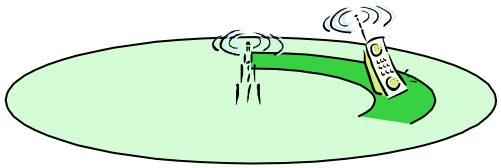
Technology used to locate mobile phones engaged in calls



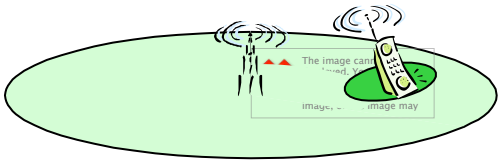
A. Cell ID



B. Angle of Arrival (AOA)



C. Timing Advance (TA)



D. Received Signal Strength (RSS)

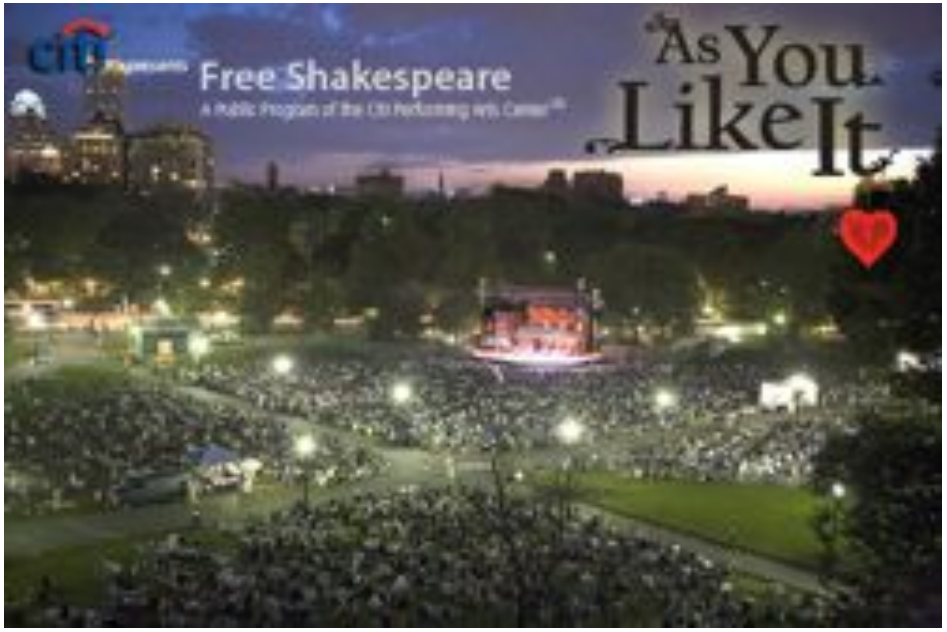
Using propagation models and irradiation diagrams, the software engine estimates the mobile phone position finding the point that minimizes the mean square error between measured and estimated mean power received by all base stations.

exhibited at the 2006 Venice Biennale of Architecture

Modeling urban mobility – special events

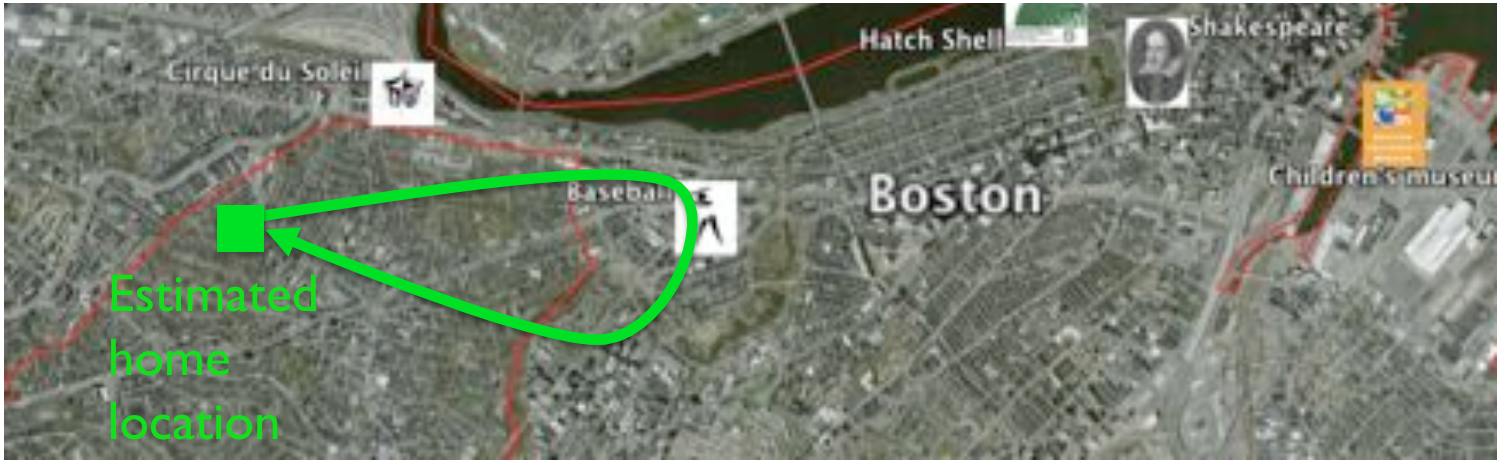
Goal: Modeling and predicting non-routine additive origin-destination flows in the city

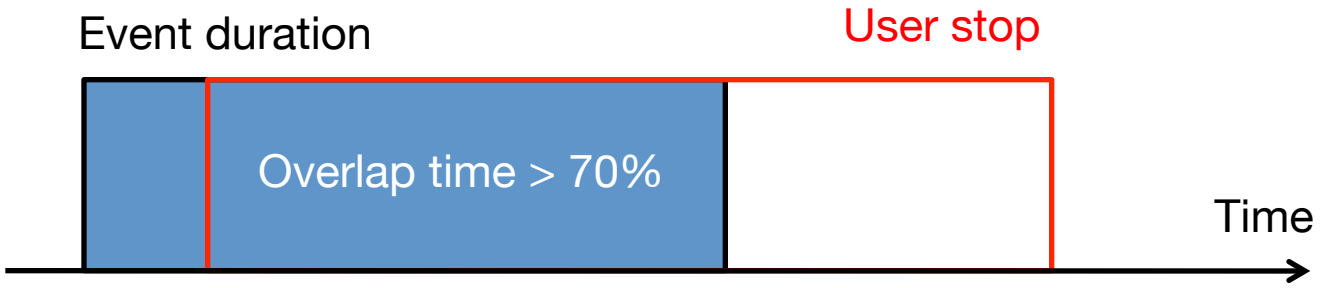
Improving event planning and management, with possible applications for emergency response



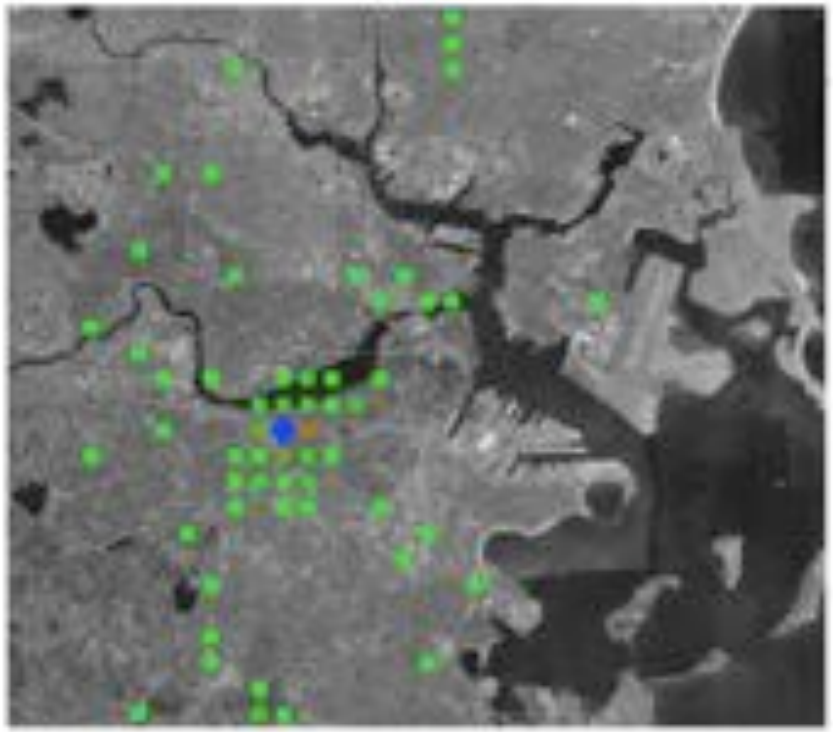
F. Calabrese, F. Pereira, G. Di Lorenzo, L. Liu, C. Ratti, The geography of taste: analyzing cell-phone mobility and social events. In International Conference on Pervasive Computing, 2010.

Attendance inference

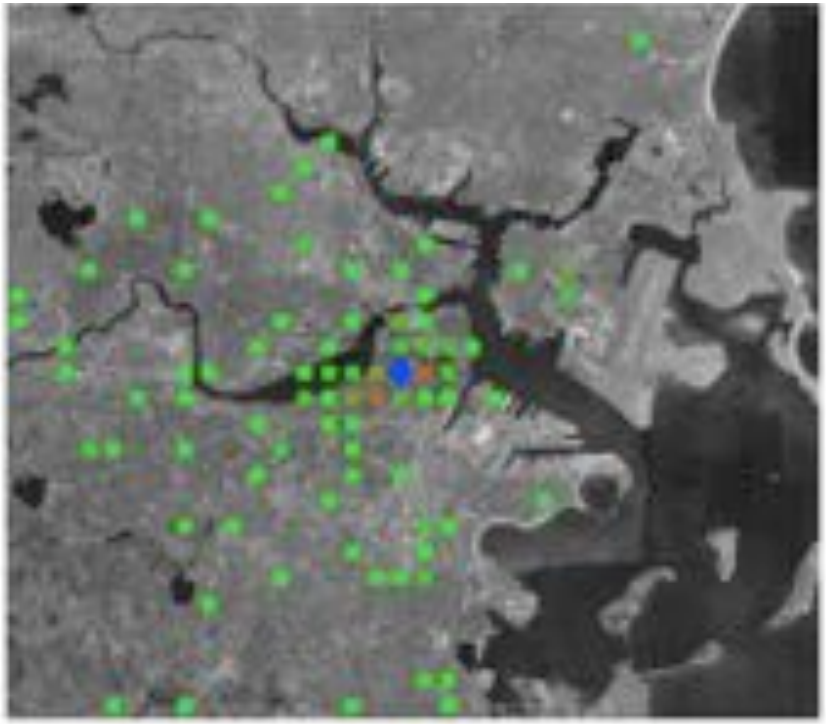




Origins of attendees



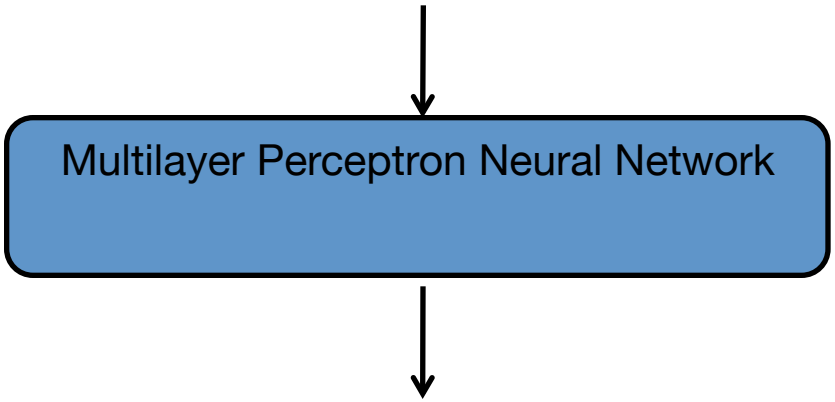
(b) Boston Red Sox vs. Baltimore Orioles at Fenway Park, 2009-9-9



(d) Shakespeare on the Boston Common, 2009-8-13

Event types and attendance origins

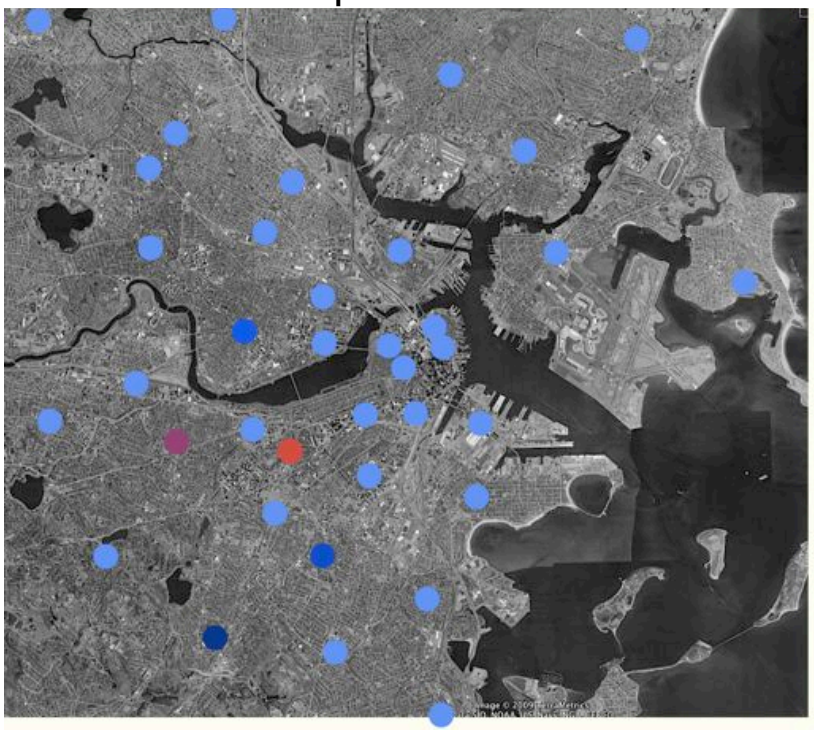
ZIPCODE	02215	02139	02114	02115	02108
COUNT	7	5	7	11	9
PERCENT.	7%	5%	7%	11%	9%



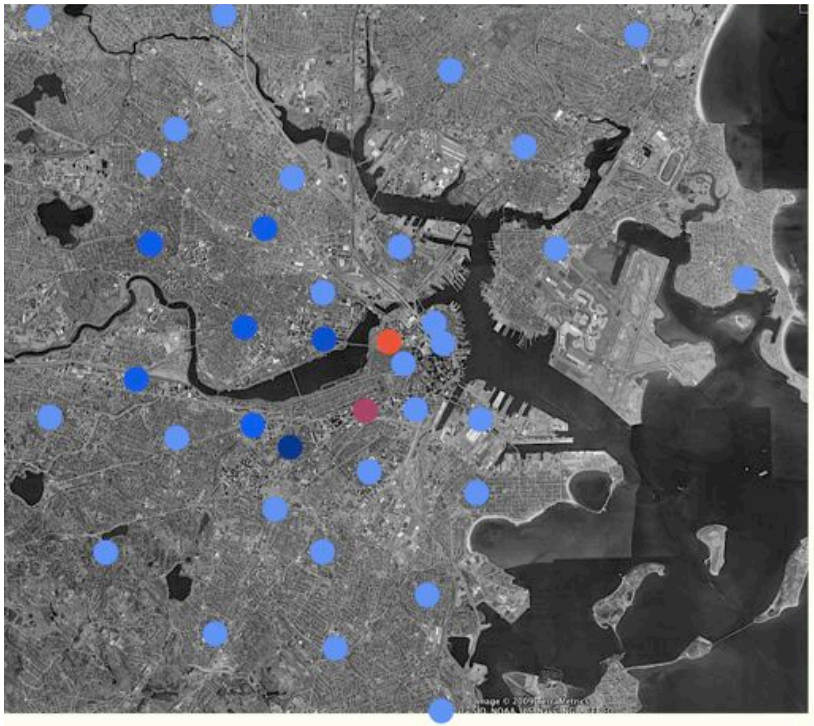
Event types and attendance origins

	All attendees		Exc. event zipcode		
Features	**Precision**	**Improvement**	**Precision**	**Improvement**	**Obs**
Fixed baseline	35%				Always choose same class
Random baseline	23.34%				Random choice
Zipcode	89.36%	54.36%	59.57%	24.57%	All attendees
Distance	51.06%	16.06%	48.9%	13.9%	All att. Resolution 2000m

Sport



Cinema

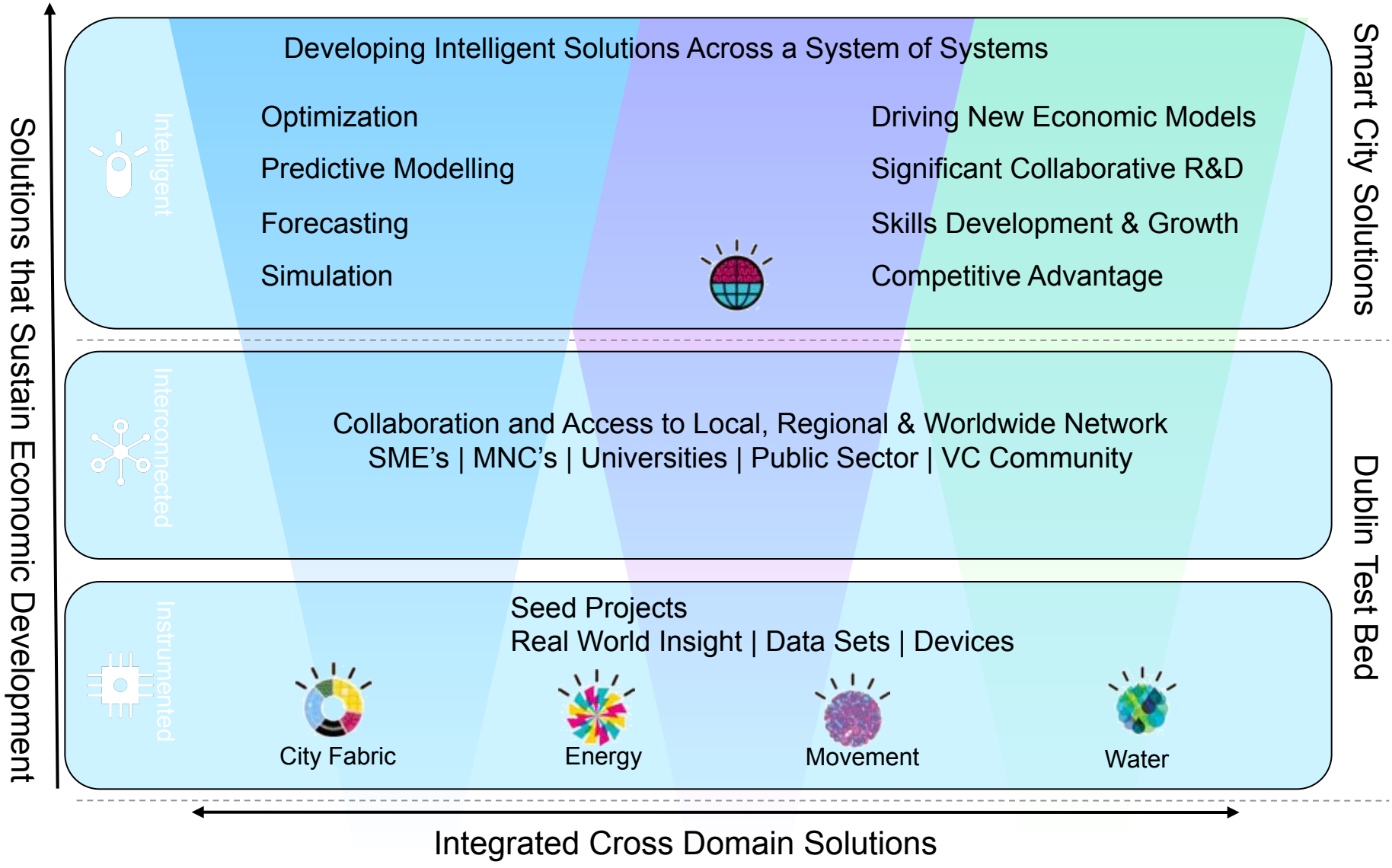


Circles are centroids of zipcode areas

Attendance probability

Low High

The Smarter Cities Technology Centre merges Collaborative Research & Smarter Cities opportunities



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Thanks

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