

LBS 2016

13th Conference on Location-Based Services
Vienna, 14–16 November 2016



Development of an LBS Research Agenda

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**ICA Commission on
Location Based Services**

ICA Commission on Location-Based Services



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Location Based Services

- Approved by the General Assembly of the ICA on 28 August in Rio de Janeiro, Brazil

- ICA: International Cartographic Association



- Term: 2015-2019
- Chair: Haosheng Huang (University of Zurich)
- Co-Chair: Jukka M. Krisp (University of Augsburg)
- ICA Executive Committee liaison: Georg Gartner (TU Wien)



Mission

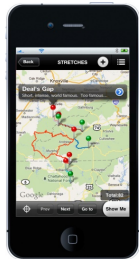
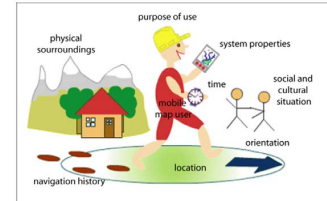
- to advance the research on LBS in all its interdisciplinary fields
 - with the aims to enable “anywhere, anytime, for anyone and anything” (4A) services

Topics of Interest



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- Any research fields related to LBS
 - Outdoor/Indoor Positioning
 - Context and User Modelling
 - User Interfaces
 - Usability, Privacy and Social Issues
 - Location Tracking and Processing
 - Mobility and ITS Applications
 - Health Applications
 - ...
- Academia, Industry, Organization...



Activities



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Location Based Services

- Commission website <http://lbs.icaci.org> and e-mailing list
 - Currently 127 members
 - Register as a member **Sign up Now!**
- International Conference Series on LBS
 - ..., LBS 2015 (Augsburg), LBS 2016 (Vienna), LBS2017/2018 (Zurich?), ...
- Other workshops in conjunction with big conferences
- Special issues
- **Initiative on developing a cross-cutting research agenda**
 - Identifying key research questions and challenges that are essential for the LBS development in the next 5 or 10 years





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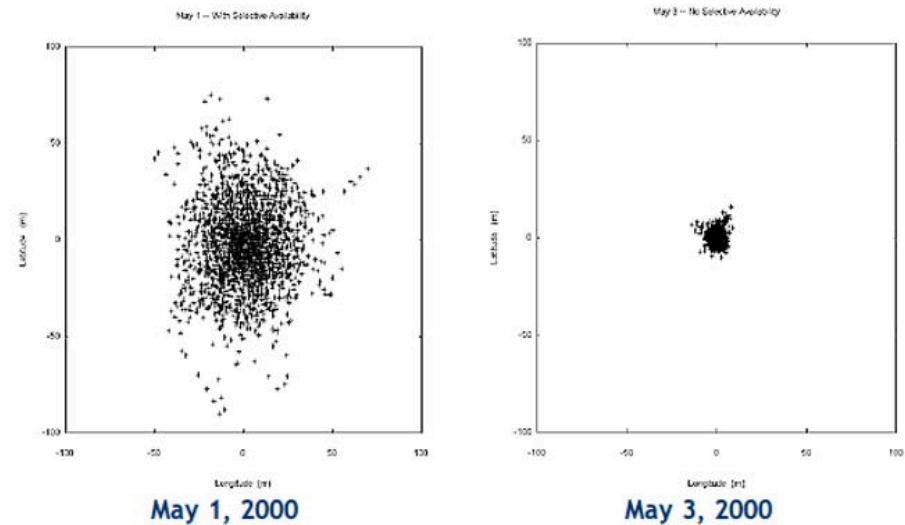
Why LBS Research Agenda?

Evolving of LBS

- In May 2000, U.S. President Bill Clinton discontinued the Selective Availability to make GPS more responsive to civil and commercial users worldwide.

GPS Accuracy Before and After SA Removal

Click either image for full size view



Source: NOAA National Geodetic Survey

Evolving of LBS



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- Since then, more and more GPS-based applications appeared.
- Strong research interests had been invested.
 - Conferences (e.g., LBS conference series), books, Journals (e.g., JLBS), ...
- → **Location-Based Services became a research field**

Raper et al. 2007



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Journal of Location Based Services
Vol. 1, No. 1, March 2007, 5–45



RESEARCH ARTICLE

A critical evaluation of location based services and their potential

Jonathan Raper*, Georg Gartner, Hassan Karimi and Chris Rizos

Information Science, City University, Northampton Square, London, EC1V0HB, UK

(Received 15 May 2007; in final form 22 June 2007; accepted 19 July 2007)

This Editorial lead article for the *Journal of Location Based Services* surveys this complex and multi-disciplinary field and identifies the key research issues. Although this field has produced early commercial disappointments, the inevitability that pervasive location-aware services on mobile devices will emerge means that much research is needed to inform these developments. The article reviews firstly: the science and technology of positioning, geographic information science, mobile cartography, spatial cognition and interfaces, information science, ubiquitous computing; and secondly the business, content and legal, social and ethics aspects, before synthesising the key issues for this new field.

Keywords: geolocation technologies; mobile mapping; ubiquitous computing

Domains of LBS

USER-RELATED

Legal, social and ethical issues

Business models

GI mobile content

TECHNOLOGICAL

Spatial cognition/interfaces

Mobile cartography

Information science

GIScience

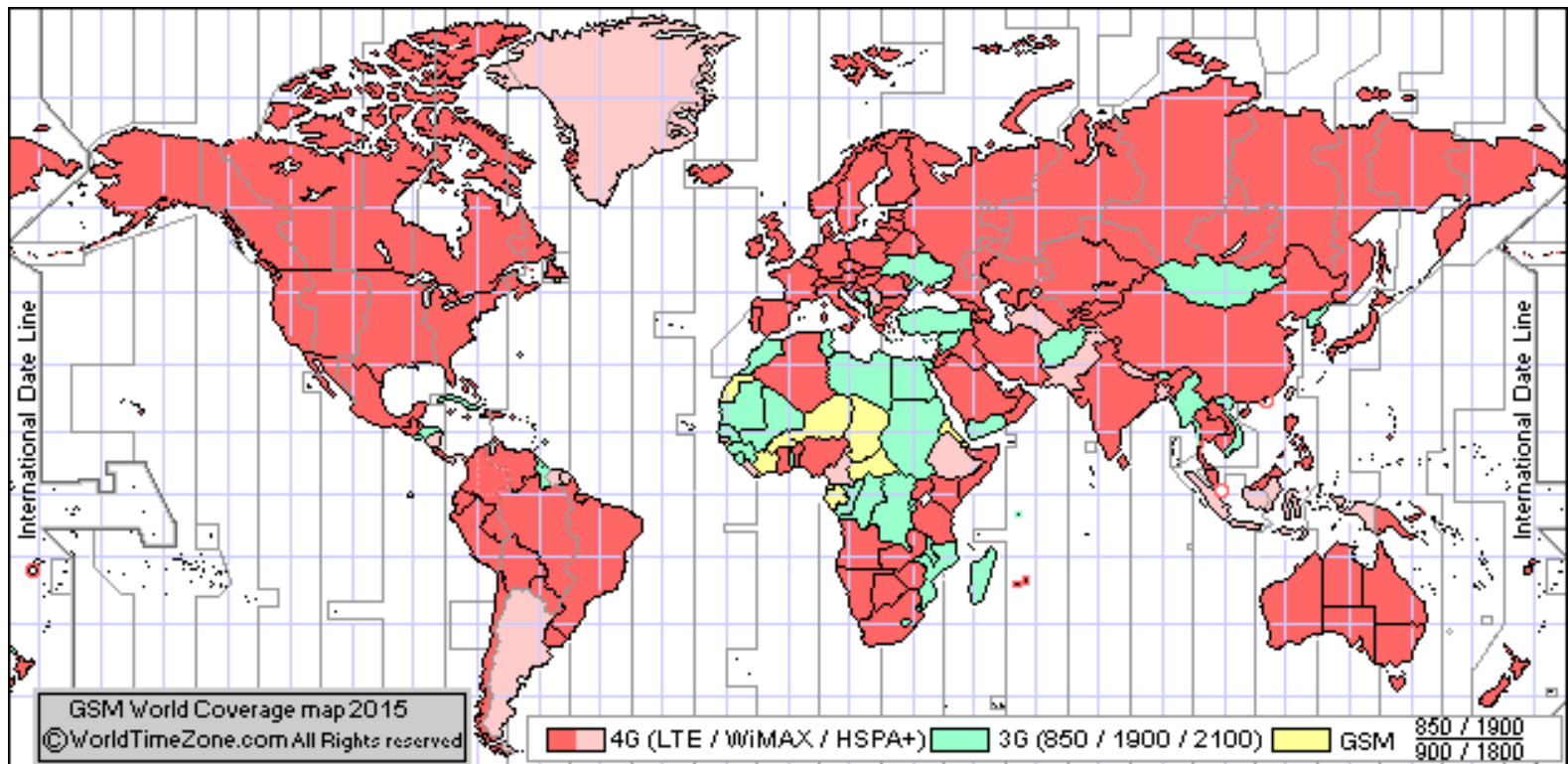
Geopositioning

Ubiquitous computing

Telecom infrastructure

3G, 4G, (5G), ...

WiFi



Positioning



GPS, Galileo, BeiDou, ...



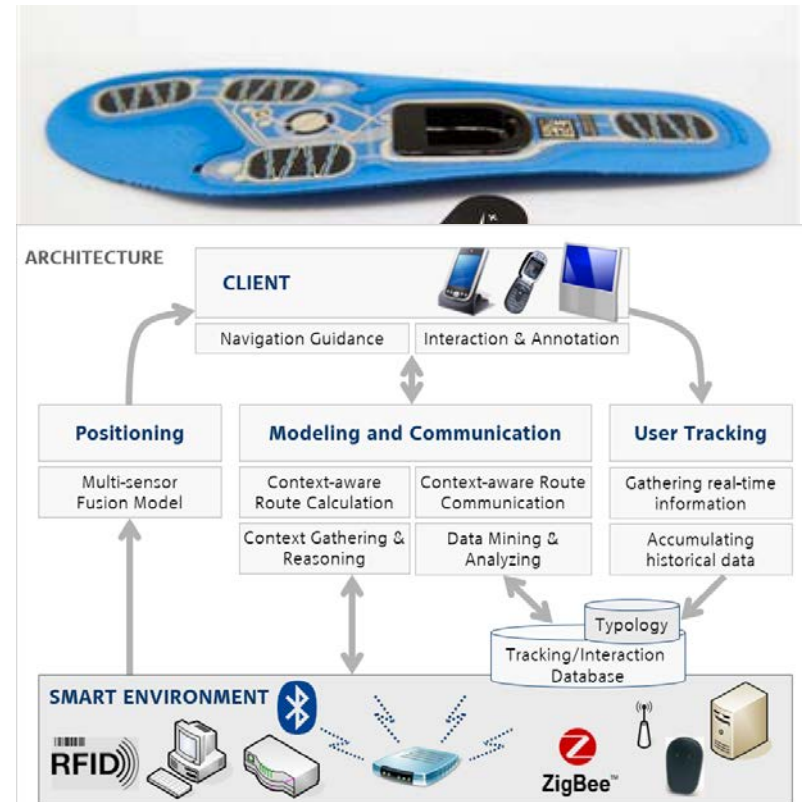
WiFi, Bluetooth, UWB, ...

Sensors / Smart Environments



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From location-based to context-aware

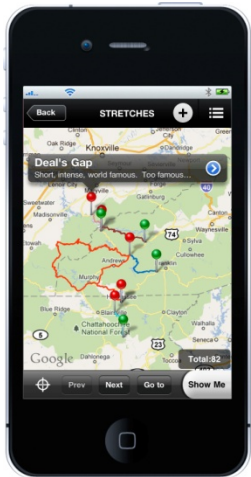


Devices / Interfaces



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Smartphones are not the only client.

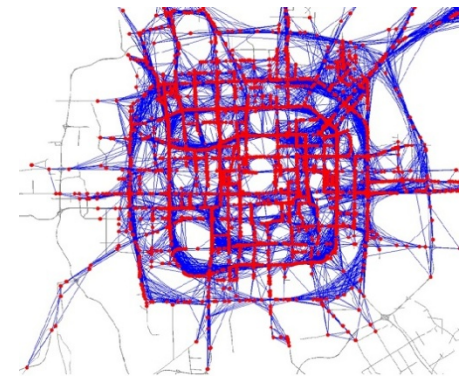
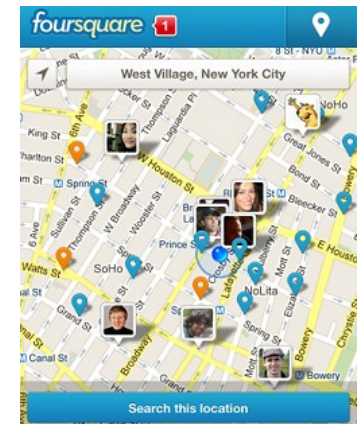
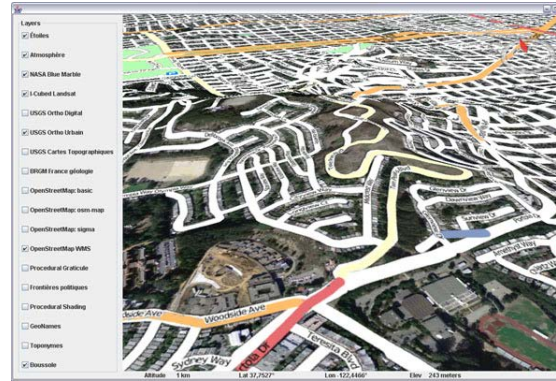


Rich Data



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Commercial and Volunteered
Open government data



More Potential Applications

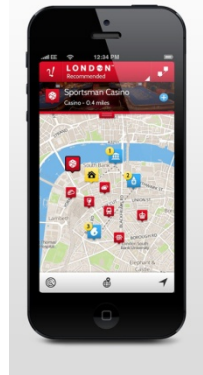
- From Navigation systems and Mobile city guide
- To more diverse applications

Intelligent transportation system



Car navigation

City guide



Advertisement



Game



Health services



Urban planning

Disaster and emergency



Agriculture



- Become more
“ubiquitous”

The Need of Interdisciplinary Research

- From Technology-oriented
- To Interdisciplinary research

Usability



Privacy



Privacy

Legal issues



Business model



blindly following GPS
Navigation Systems



Ethical issues

- The rapid technological development and the potential ubiquity of LBS → opportunities and challenges
- **It is time to develop a cross-cutting research agenda**
 - identifying key research questions and challenges that are essential for the LBS development in the next 5 or 10 years.

Initiative on developing a cross-cutting research agenda



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- A joint activity of the research community
 - Call for one-paragraph proposals
 - Circulating a first list of “key problems” for comments/feedback
 - LBS research agenda workshop
 - Improving and refining the list of “key problems”
 - Publication of the LBS research agenda

Initiative on developing a cross-cutting research agenda (1)



- Step 1: Call for one-paragraph proposals (March-July 2016)
 - What are the “big problems” that should be addressed to bring LBS into a higher level?
 - 31 proposals

Summary of one-paragraph proposals

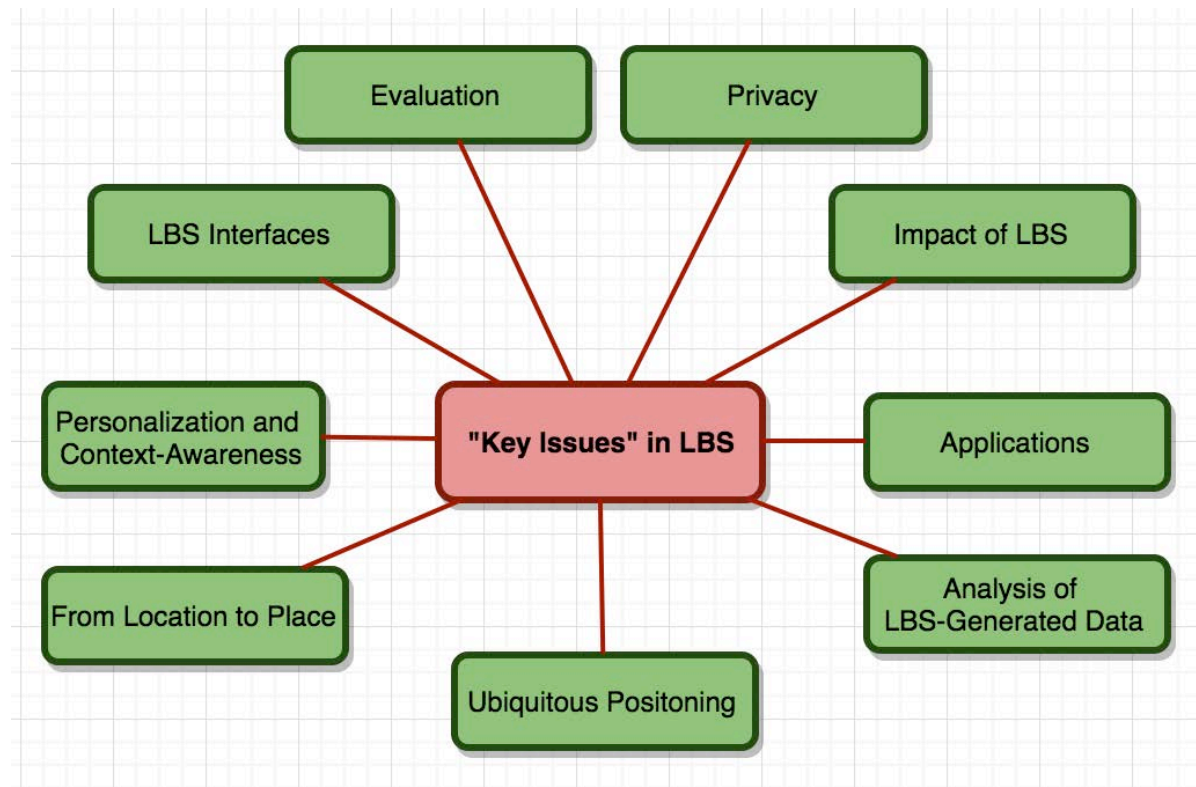
Name	Keywords
Klemen Kozmus (Slovenia)	Indoor Navigation
Haozheng Huang (Switzerland)	Side effects of LBS (poor spatial knowledge acquisition) Place-based LBS Indoor behavior modelling Context-awareness LBS interfaces
Domokos Esztergár-Kiss (Hungary)	Travel behavior analysis --> travel guide
Eko Sedyono (Indonesia)	Cadaster mapping
Kai-Florian Richter (Sweden)	Autonomy vs. Automation
Dirk Wenig (Germany)	Sustainable LBS (to support spatial learning)
Martin Raubal et al. (Switzerland/Germany)	Comprehensive evaluation framework/toolkits
Sebastian Feld, Martin Werner (Germany)	Multipurpose Usage of Digital Maps
Johannes Schöning (Belgium)	space usage rules, e.g., „no smoking here“
Jürgen Döllner (Germany)	Automatic creation of „mental maps“
Jochen Wendel (Germany)	Analytical LBS
Rui Li (USA)	Supporting spatial knowledge acquisition (spatial awareness)
Huanfa Chen (China)	Dynamic vehicle routing (dynamic demands)
William Mackaness (UK)	Impacts and social-technical implications of LBS
M.R. Malek (Iran)	Location-based social networks (LBSN)
Catia Real Ehrlich and Jörg Blankenbach (Germany)	Indoor positioning (sensor fusion)
Bonan Wei, Jochen Schiewe (Germany)	Visual guidance of mix indoor/outdoor navigation
Liqiu Meng (Germany)	Connections between locations
Min Lu (Japan)	Context-aware and personalized map
H. Sebnem Duzgun (Turkey)	Analysis of LBS data
David Jonietz (Switzerland)	Personalization
Dominik Bucher (Switzerland)	Standardization and interoperability of LBS and Internet of Things services
Stefano De Sabbata (UK)	Context-awareness LBSN data: quality
Andrei Popleteev (Luxembourg)	Global indoor localization (less infrastructure-dependent)
Thomas Liebig (Germany)	Big data analysis
Peng Jia (China)	Behavior analysis (location tracking) for health-related app.
Johannes Scholz (Austria)	Indoor Navigation
Nina Polous (Germany)	Consider location dynamics and connection
Guenther Retscher (Austria)	Indoor positioning (hybrid approach, cooperative)
Konstantinos Papangelis (China)	Usability and privacy Evaluation methods
Jukka Krisp (Germany)	Better map Location-based games Privacy and personalization collective support

Initiative on developing a cross-cutting research agenda (2)



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- Step 2: Compiling a first list of “key problems”
 - 31 proposals → Compiled by the Commission Chairs and several invited experts (Georg Gartner, Martin Raubal, Liqiu Meng, Guenther Retsche) → A first list of “key problems”



- **1. Ubiquitous positioning**

-



First list of “key problems”



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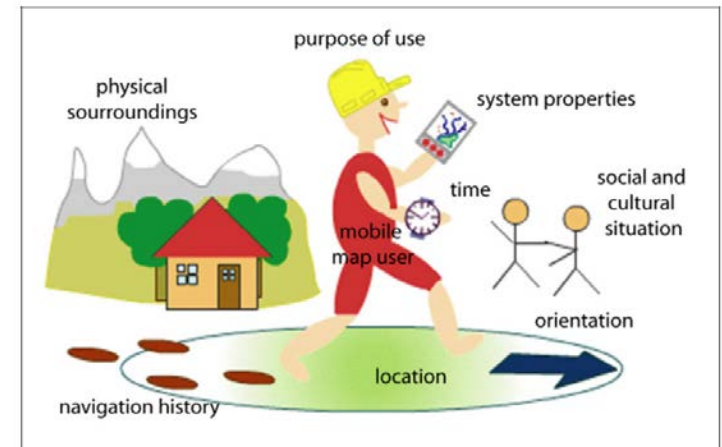
• 2. From location to place

- How can we enrich the abstract concept of “location” to reflect people’s understanding of place, both individually and collectively, in LBS applications?
- How can place, which relates the abstract word with human experience, experiences and interaction, be modeled for LBS?
- How can “space usage rules” (e.g., “no smoking here”) be modeled and used in LBS?
- How can place dynamics and (semantic) connection be modeled and used in LBS?
- How should we design LBS to consider place (place-based LBS)?



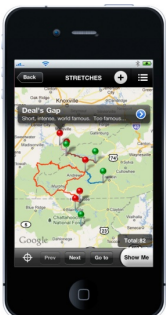
First list of “key problems”

- **3. Personalization and context-awareness**
 - What is context?
 - In which ways can context be modeled and used in LBS?
 - How can context-awareness and personalization be provided in LBS?
 - Can we find a balance between autonomy and automation (human-in-the-loop)?
 - How can we develop LBS to support collective actions and activities?
 - How can LBS make use of and contribute to “internet of things”?



First list of “key problems”

- **4. Towards more non-intrusive and “natural” interface for LBS**
 - How can non-intrusive and „natural“ interfaces be developed for LBS?
 - How can we employ newly emerging mobile devices (e.g., smart watches, smart glasses) for LBS applications?
 - How can cartographically pleasing interfaces be provided in LBS?
 - How can visual, sound, and tactile methods be integrated to effectively communicate spatial information in LBS?



First list of “key problems”

• 5. Evaluation

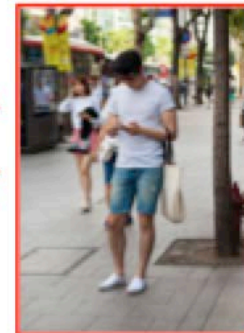
- How can a comprehensive framework (beyond usability) for LBS evaluation be developed, considering user interface, user properties and skills, cognition, device and service properties, environmental factors, and social aspects?
- What is the usability of user research techniques and methods (longstanding and emerging) in LBS research (in laboratory and in the field)?



Environment: reality
through the eyes



Navigation System



Where am I?
Which way to take?



Mental Map (perception/
cognition of reality) and
Preferences

First list of “key problems”

- **6. Privacy**

- What is privacy in LBS?
- Can we computationally model privacy in LBS?
- How can we best address users’ privacy in LBS applications?



First list of “key problems”

- **7. Side effects and social impact of LBS applications**
 - How do LBS (e.g., navigation systems) influence people’s spatial knowledge acquisition, spatial awareness and spatial ability? Why it happens?
 - How can we design LBS that facilitate people’s activities and decision-making without harming their spatial abilities?
 - How do LBS influence the way people interact with each other and their behaviors at different environments?



First list of “key problems”

- **8. Selected Applications (not exclusive)**
 - Indoor and outdoor pedestrian navigation
 - Transportation (navigation, safety)
 - Mobile guides
 - Mobile healthcare (Ambient living)
 - Smart cities (smart mobility, smart living, smart governance, smart people, ...)
 - Location-Based Games (e.g., PokemonGo)
 - Disaster management
 - Maritime applications
 - Self-driving cars

First list of “key problems”

- **9. Analysis of LBS-generated data (e.g., tracking data, social media data)**
 - Theories and data models of location-based social media data and tracking (outdoor and indoor)
 - Analysis and visual analytics for social media data and tracking data
 - Privacy-preserving analysis
 - Applications: healthcare, marketing, tourisms, ...

Initiative on developing a cross-cutting research agenda (3)



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- Step 3: LBS Research Agenda Workshop
 - Aims: refining and discussing the first list of “key problems”, developing a work plan for the research agenda paper
 - 13.11. 2016, 13:30-18:00
 - 22 participants
 - Two Group Discussions



Initiative on developing a cross-cutting research agenda (3)



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- Some initial summary of the discussion results
 - What is LBS?
 - Is positioning one of the central issues in LBS?
 - Focusing on application domains instead of particular types of LBS applications
 - Expanding “privacy” to “ethical issues”
 - Impact of LBS applications
 - Why “PokemonGo” attracts so much attention?
 - ...
- A “mind map” to visualize the research agenda

Initiative on developing a cross-cutting research agenda (4)



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- Next Steps:
 - Refining and improving the first list of “key problems”
 - Circulating the revised list to the LBS community for comments & feedbacks
 - LBS research agenda paper (first draft by Summer 2017)



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Please help shaping the research agenda!

<http://lbs.icaci.org/research-agenda/>

**Any comments and suggestions are
welcome!**

Thank you for your attention!