UBICOMM - EMERGING
The Internet of Everything:
Challenges of Web of Things in Smart Cities

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The Tenth International Conference
on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM 2016)
October 9 - 13, 2016, Venice, Italy

Web as an application platform for the real world things

- IoT gives device an IP address and makes it interconnected in Internet
- But networking alone doesn't enable success and practical usability of IoT
- Customers are looking for practical services and web is the most commonly accepted tool for accessing services in the virtual space

Main groups of challenges:

- Security and Privacy – existing technologies often are not applicable in WoT of large-scale, distributed, heterogeneous and low-capability smart things
- Heterogeneity and Scalability – adoption of WoT requires us to be prepared to a tremendously huge number of devices to be integrated to the existing Web
- Search and Discovery – things need to discover the existence, functionality and information of their desired web services
- Ambient Intelligence – goal of WoT is to build an ecosystem that can provide user-oriented and environment-aware services, i.e., the web services shall be sensitive and responsive to changes of environment and the user's presence

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The Internet of Everything for Smart Museums: Making Cultural Heritage Knowledge Usable and Creatable by Visitors and Professionals

Panel on UBICOMM / EMERGING
The Internet of Everything: Challenges of Web of Things in Smart Cities
NexTech 2016, October 9–13, 2016 — Venice, Italy

The Internet of Everything for Smart Museums

Making Cultural Heritage Knowledge Usable and Creatable by Visitors and Professionals

- Ideas on the use of emerging IoE capabilities for creating "smart museums"
- Visitors and professionals
  - operate and cooperate in one cultural space,
  - interact with surrounding exhibits,
  - interpret local and global information about the exhibits,
  - collaboratively produce new knowledge for self-study.

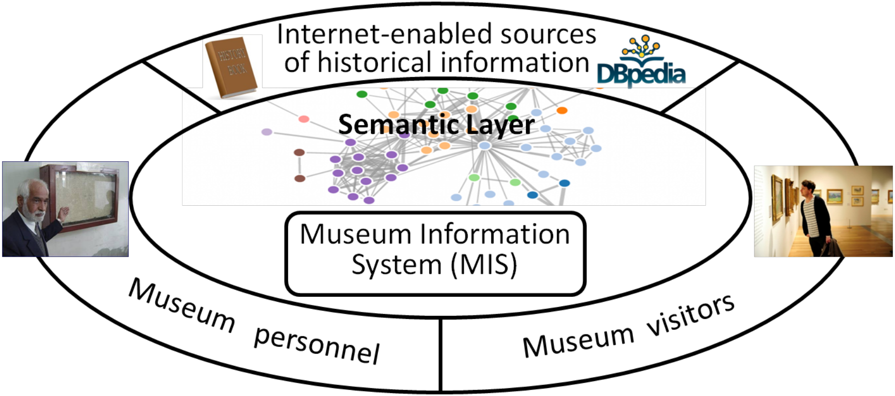
Information Services

- Provided information (not data) is meaningful in a such a way that it can be interpretable by the user in accordance with the user's needs and current situation.
- Provided information is subject to appropriate exposition (visualization) aiming at effective perception and interpretation by the user.
- Provided information is a result of search and reasoning over the multiple information sources.
- Provided information includes explicit representation of the semantics.
- Provided information acts as assistance or recommendation.

Classes/Layers for Museum Services

1. Description of exhibits is delegated to the exhibits themselves, i.e., explanatory information expanses from a centralized information system to the edges.
2. Exhibits are transformed into IoT smart objects. In addition to the advanced self-explanatory function they are able to complement their local knowledge with Internet resources, including web services and social networking activity.
3. Information about exhibits and other sources of historical data are semantically enriched and integrated. This semantically integrated corpus of historical knowledge is applied for learning (visitors), exposition construction (museum personnel), and historical analysis (professionals).

Semantics Need Effective Use



Layered Function Structure

Cultural space for service-oriented knowledge application
visitors learning, exposition construction, historical analysis

Layers of service intelligence	Functions of information processing for services
3. Semantic enrichment	Knowledge creation
	Hidden knowledge analysis
2. IoT-aware information exchange	Interaction of visitors and professionals
	Interaction with smart objects
	Community feedback
1. Information expansion to edges	Pre, during, post visit guidance
	Explanatory description of exhibits

Service consumption properties

- Mobile access
- Service-oriented delivery
- Information-driven activity
- Assistance and recommendation
- Personalization

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BIG DATA REPRESENTATIVENESS FOR SMART CITY APPLICATIONS

Ivana Semanjski / Thursday, October 13, 14:00

The IoE: Challenges of Web of Things in Smart Cities/ Panel on UBICOMM - EMERGING

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IARIA

move i-know

HUMAN MOBILITY AND URBAN DYNAMICS

Urban population of the world has grown rapidly from 746 million in 1950 to 3.9 billion in 2014 (United Nations, 2014)

Urban mobility contributes to 25% of the global CO_2 emission (IEA, 2014)

Congestion costs nearly 100 billion Euro, or 1% of the EU's annual GDP (European Comission, 2007).

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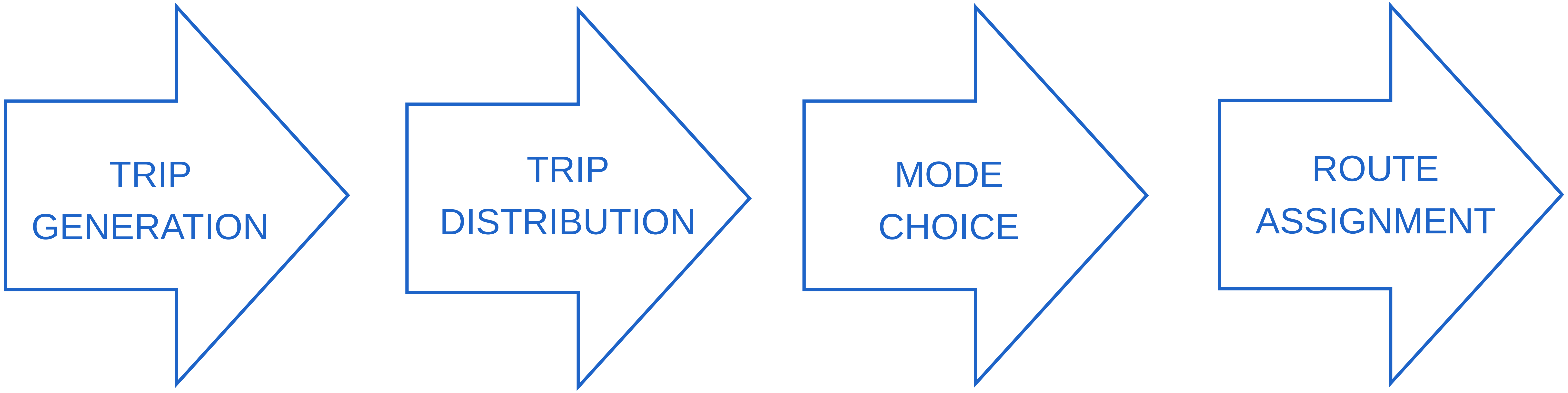
TRANSPORT PLANNING

– Iterative process of defining future policies, goals, investments and designs to prepare for future needs to move people and goods to destinations



DATA COLLECTION EVOLUTION

- Surveys and interviews (paper/phone → record or state travel behaviour)

- Travel diaries (systematically note → usually during one full week → travel behaviour details)

- GNSS (high resolution spatial and temporal data → potential to overcome some of the traditional data collection disadvantages)

- Sensing devices

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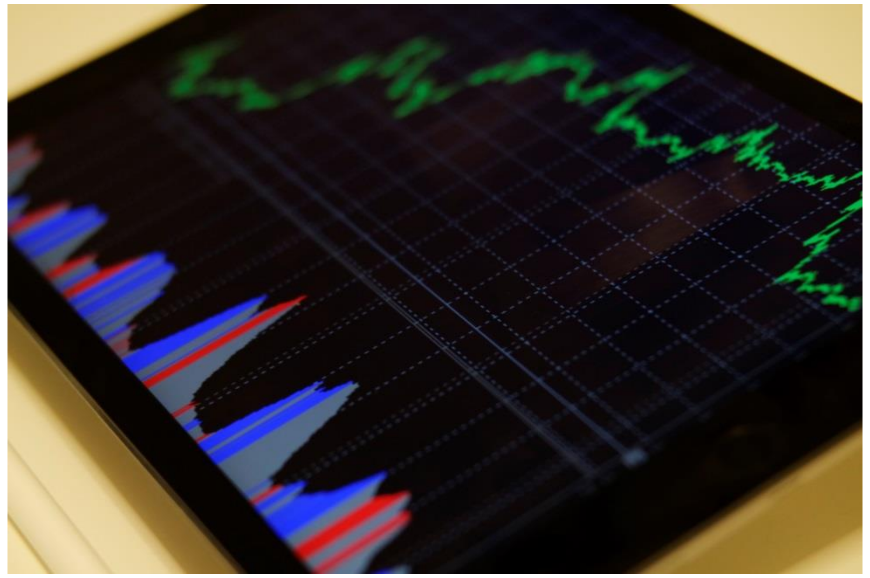
BIG DATA FOR MOBILITY STUDIES

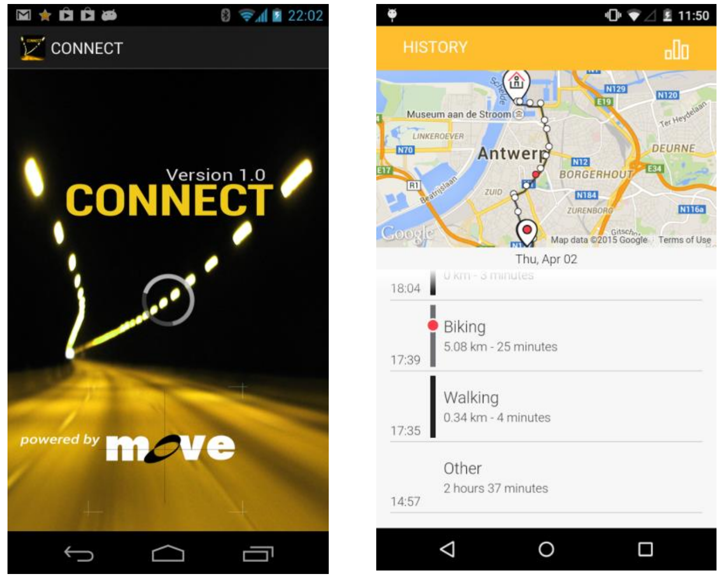
- Mobile phone data

CARRYING A MOBILE PHONE HAS BECOME A HABIT	PERSONAL DEVICES - INDIVIDUALS' BEHAVIOR	PENETRATION RATES FOR MOBILE DEVICES HAD 12-FOLD INCREASE SINCE 2007 (ITU, 2015)	SMARTPHONES INTEGRATE VARIETY OF SENSORS (GNSS-CHIPSETS, ACCELEROMETERS ETC.)

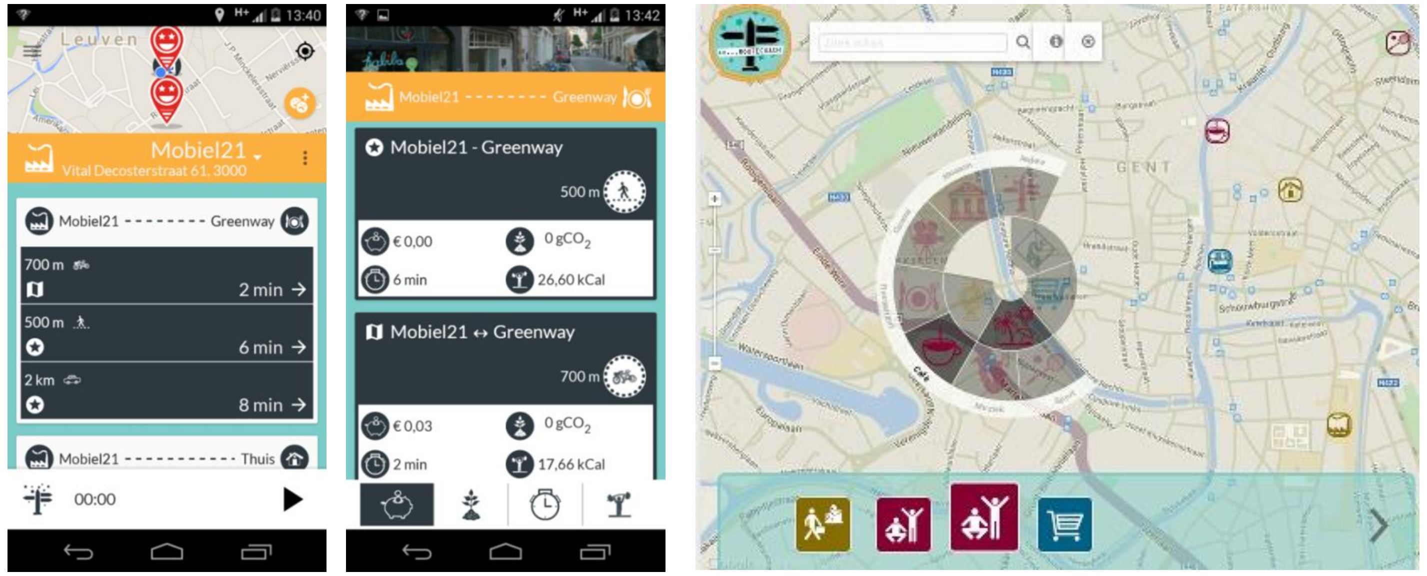
CALL DETAILS RECORD



PASSIVE DATA COLLECTION



ACTIVE DATA COLLECTION



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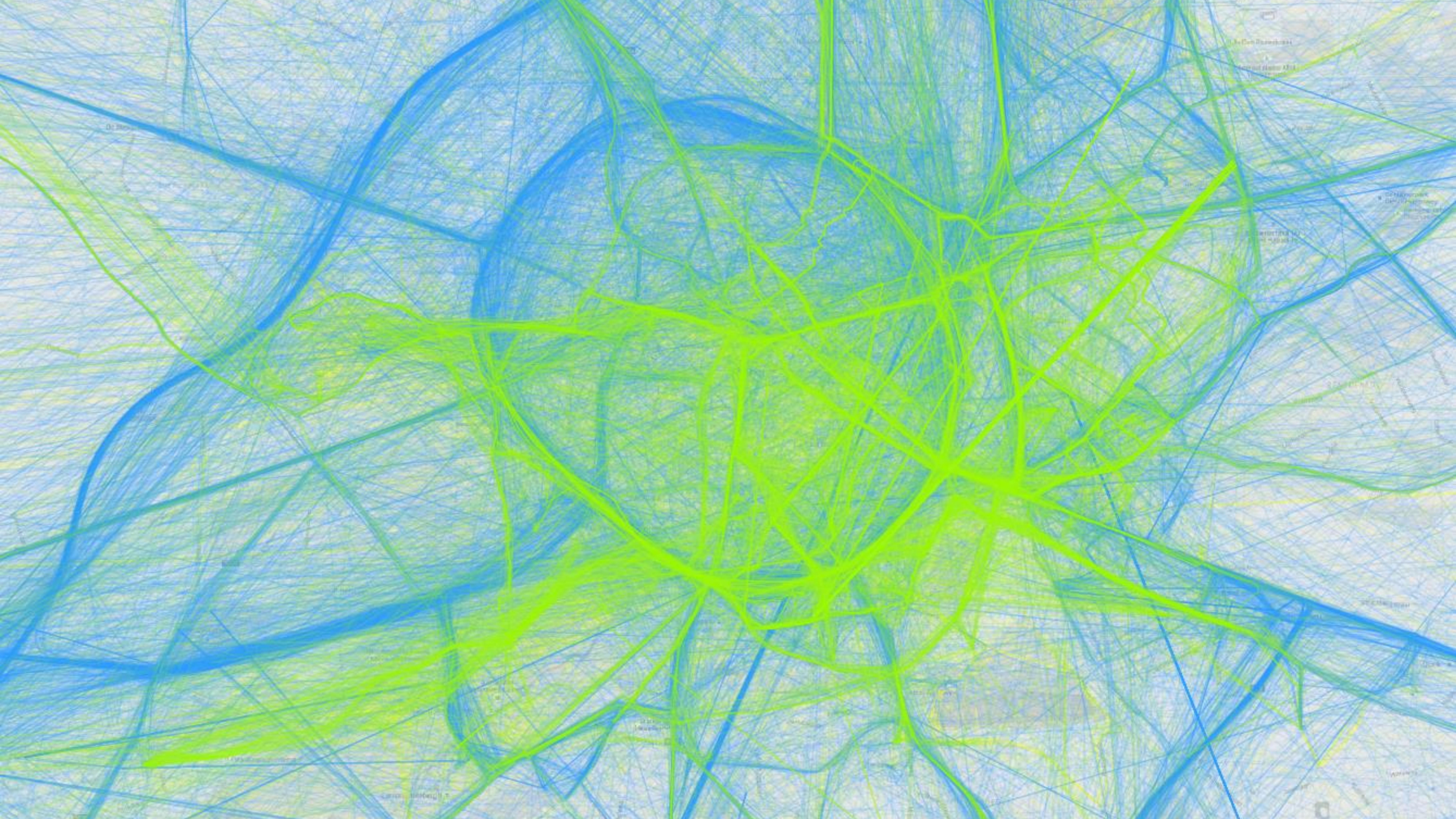
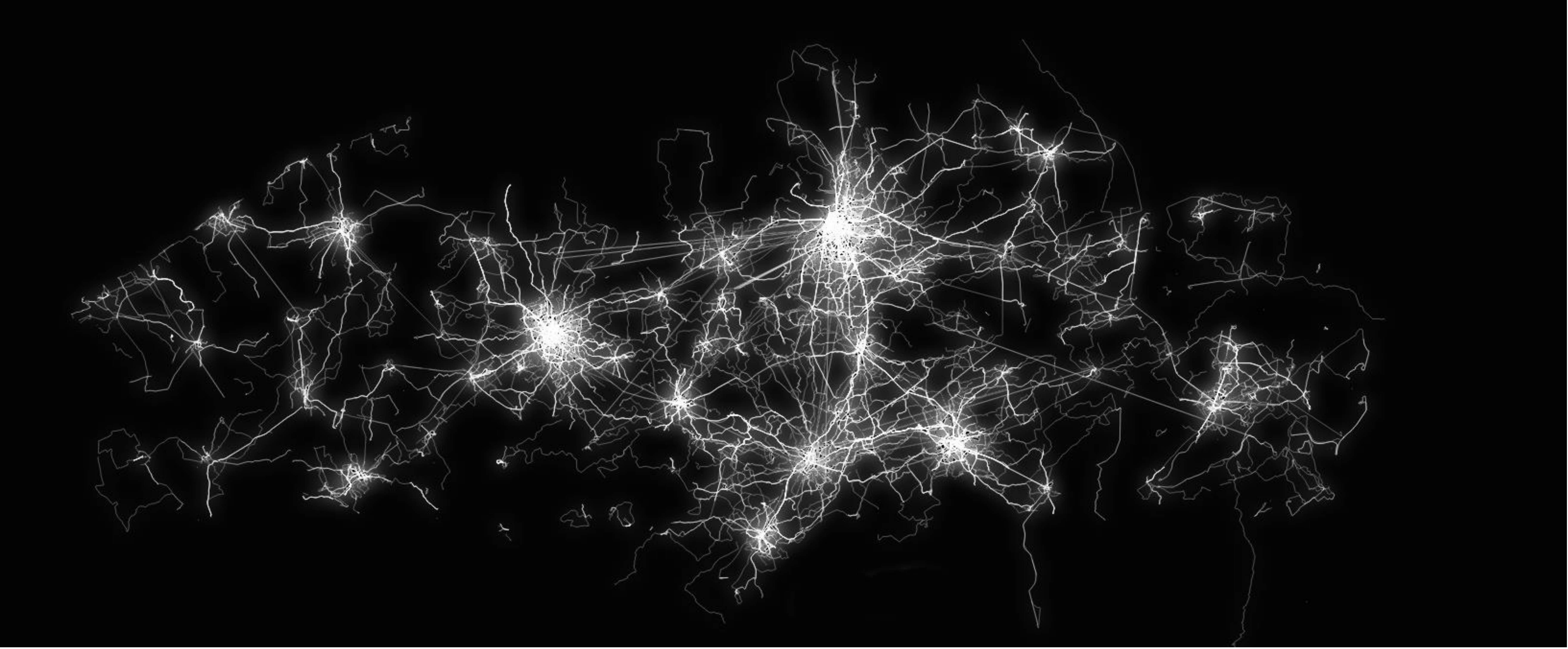
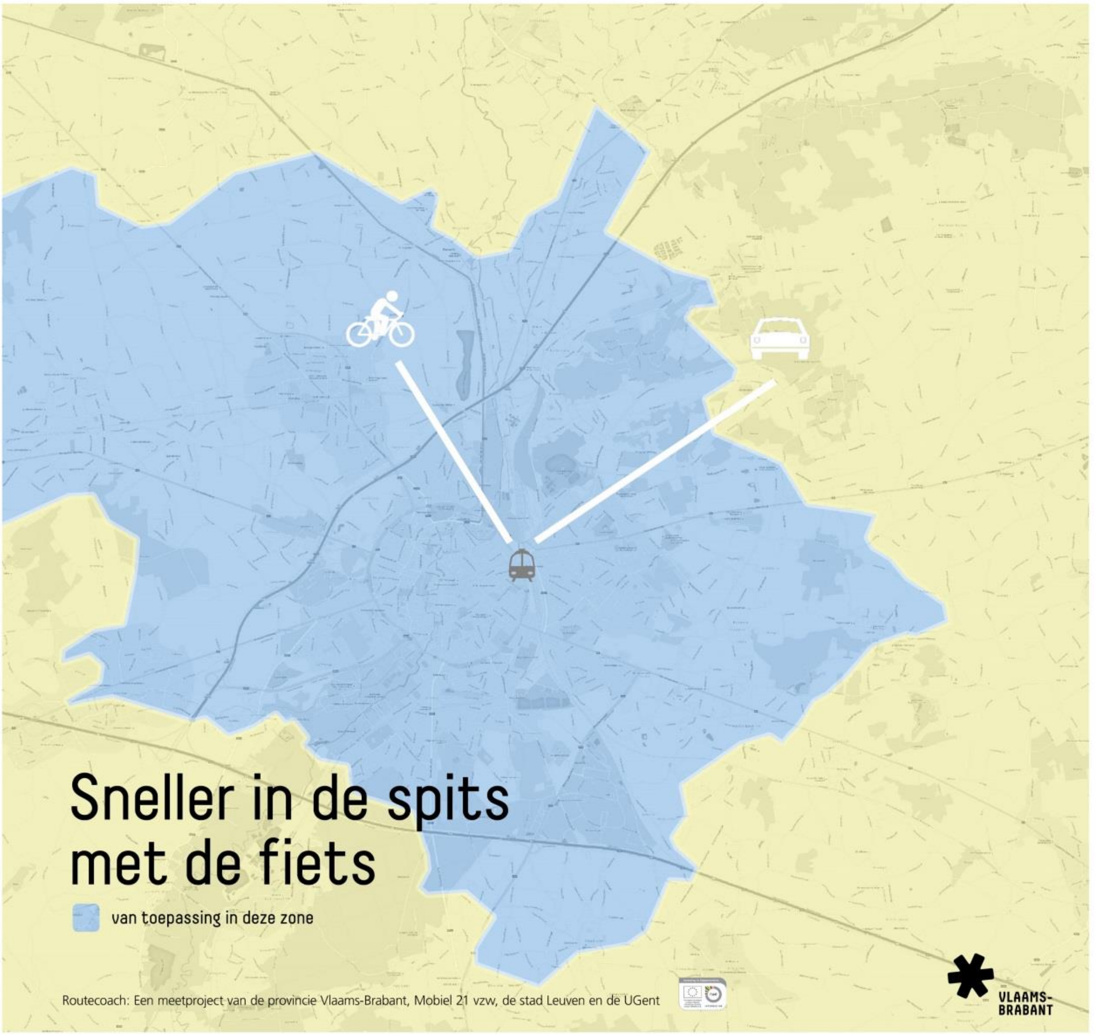




GETTING SMARTER



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OPEN CHALLENGES

- representativeness of big data
- bridging between small data (surveys and travel diaries) and big data for urban mobility studies
- innovation and data generation driven smart cities’ decision making and planning (Policy 2.0)
- enriched traditional urban planning approaches - supporting development of more efficient and equitable urban systems
- and many many more...

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Panel

The Internet of Everything: Challenges of Web of Things in Smart Cities

Michele Ruta

Politecnico di Bari, Bari (Italy)

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Toward Wise Cities

Current Cities

- Static and not flexible architectures
- Constrained interoperability
- Basic usage scenarios
- User-driven interaction (low autonomicity)

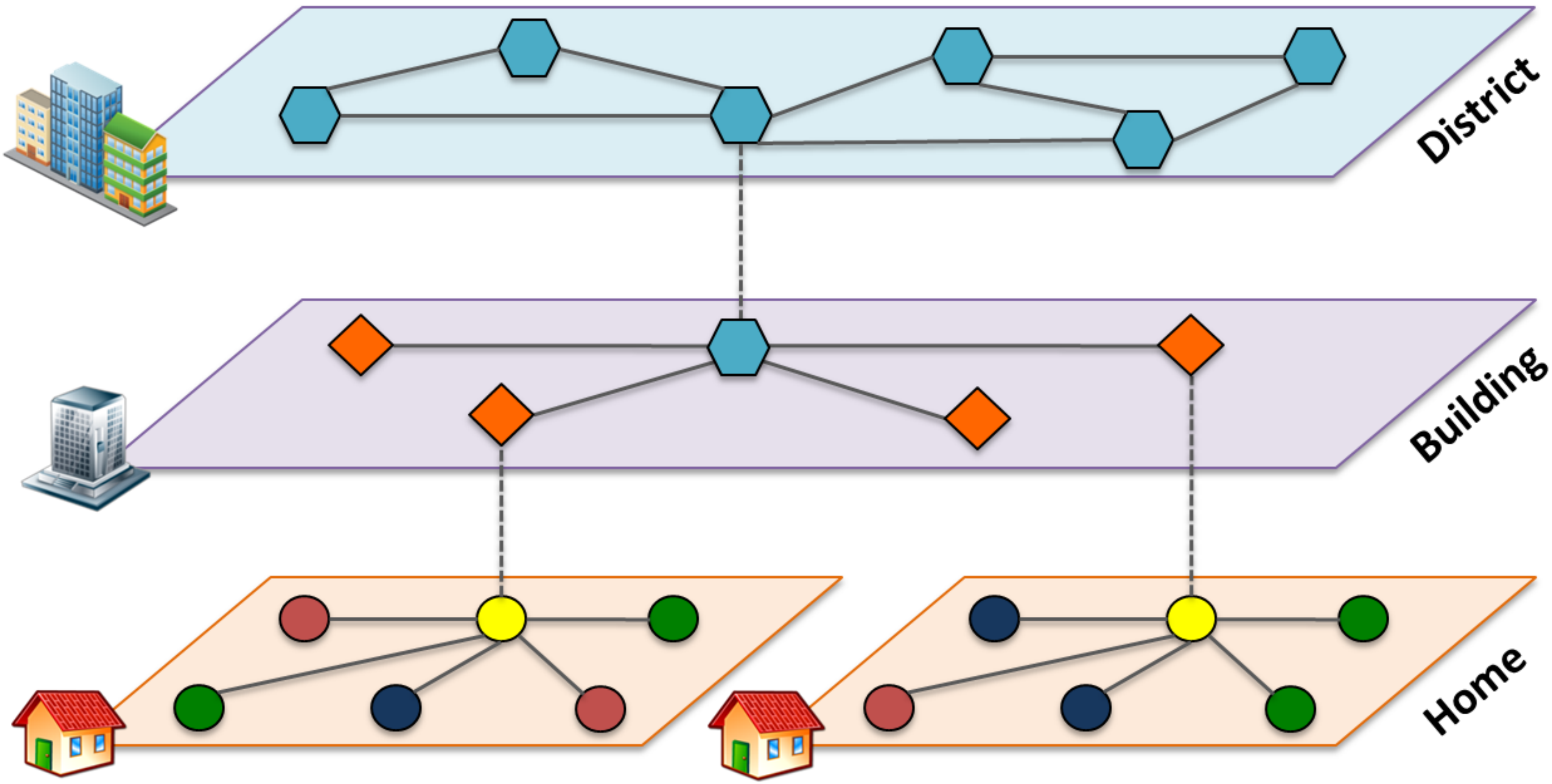
Smart Cities

- Flexible and scalable
- Services and resources accessible via agent-oriented frameworks
- Concurrency, cooperation, negotiation enabled among different systems/resource providers

Semantic-based Wise Cities

- Improved interoperability
- Rich description of user/service profiles
- Decentralized architecture supporting autonomous device-driven interactions

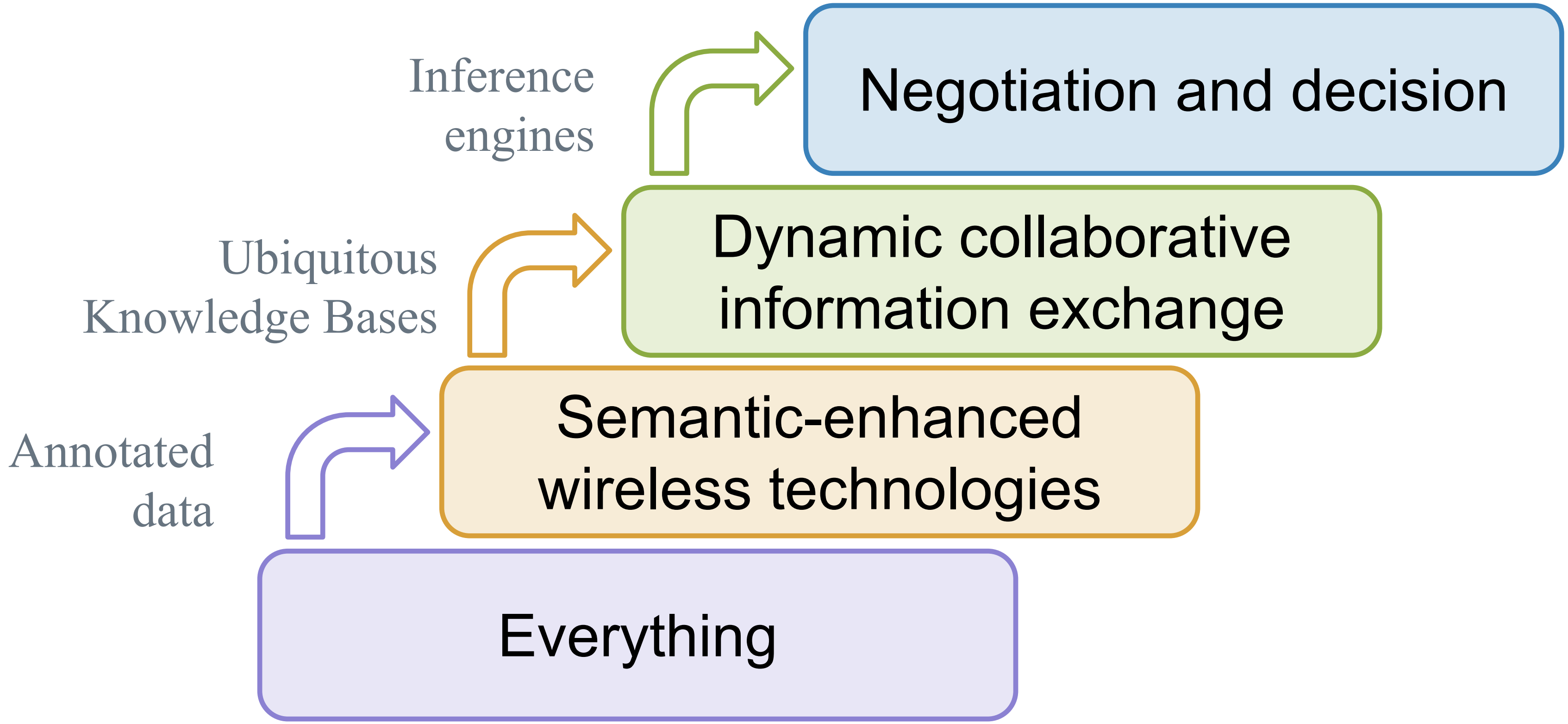
A multi-level challenge



Approach: multi-agent systems for decentralized control

The Semantic Web of Things

From sensing to automated decision in pervasive contexts



SWoT: technologies

A. Integrating knowledge representation in standard wireless communication protocols

- Bluetooth
- Radio Frequency IDentification (RFID)
- ZigBee
- Wi-Fi (IEEE 802.11)
- EIB/KNX (Konnex)
- CoAP
- OBD-II (On-Board Diagnostics)
- Physical Web

B. Optimized inference engines for resource-constrained computing platforms

- Mobile devices: Android, iOS
- Embedded and single-board computers: Raspberry Pi, Intel Edison, Arduino, UDOO
- Knowledge-based robots: drones, rovers

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Github repository: github.com/sisinflab-swot