Ein offener Markt für digitale Mobilitätsservices
Erster ITS Deutschland Kongress Hypermotion, Frankfurt, 21.11.2017
Prof. Florian Matthes

Lehrstuhl für Software Engineering betrieblicher Informationssysteme (sebis)
Fakultät für Informatik
Technische Universität München
www.matthes.in.tum.de
Towards an open market of digital mobility services

- The digital transformation of mobility and transportation
- Challenges for the established players

The TU München Living Lab Connected Mobility

Outlook
Cars are becoming a victim of their own success

Mittlerer Ring, München, Germany
Increasing automation
- Drivers become passengers

New mobility options
- E-bike, E-scooter, Segway, Hyperloop, …

Vehicle communication and connectivity
- Many-to-many communication opens new possibilities

Mobility services and shareconomy
- from ownership to access
“Something interesting is happening“
Tom Goodwin

The world’s most valuable retailer…
… has no inventory

The world’s largest taxi company…
… owns no fleet

The world’s most popular media owner…
… creates no content

The world’s largest accommodation provider…
… owns no real estate

Source: http://techcrunch.com/2015/03/03/in-the-age-of-disintermediation-the-battle-is-all-for-the-customer-interface/
Competition by strong customer-focused digital players

- Uber
- Apple Maps
- Apple Siri
- Apple Passbook
- Apple Wallet
- Apple Watch
- Google Maps
- Google Android
- Google Analytics
- Google Now
The mobility market is highly fragmented

- **Infrastructure**: Urban vs. rural areas

- **Culture**: Munich vs. Copenhagen vs. Singapore vs. Mexico City

- **Mobility demands**:
  - School kids, students
  - Families
  - Tourists
  - Business travelers
  - Elderly people
  - Handicapped people
  - Enterprises
  - Cities & public services (police, fire brigade, medical doctors, …)

- **Legislations**: EU, US, China, …
  - Privacy, liability, financial risks,
**Vison: An ecosystem of mobility-related services integrated in a user-centered way**

Mobility service providers

Value-adding service providers

- **My fleet, my data, my apps, my customers, …**

  **Example: Car2Go (Daimler)**

- **Seamless customer-centric integration of all mobility services.**

  **Example Apple: Maps, Calendar, Wallet, Siri, Third-Party Apps**
Example: Moovel (Daimler)
Acquisitions and partnerships
BMW GROUP, SIEMENS, HERE

Example: Connected Mobility Lab

PERSONALISIERUNG

ANWENDUNGEN

MOBILITÄTSANGEBOT

PARTNER

PLATTFORM

DATEN

Core Services

Security
Accounting
Performance Management
Identity Management
Data Management

Core Services

Payment
Shopping
Travel
Media
Smart Home
Lifestyle

DATEN

Verkehrsinfo
Fahrzeug Daten
Karten
U-Bahn
Bus
Car Sharing
Bike Sharing
Parken

Anbieter A
Fahrzeug
Wearable
Smart Watch
Anbieter A
Smart Device
Anbieter B
Smart Device
Anbieter C
Smart Device
Anbieter D
Smart Device
Anbieter A
Computer
Anbieter D
Computer

Datum / Prozesse

Mobilitätsanbieter

Smart City

Weitere Dienste
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The TU München Living Lab Connected Mobility

- Guiding principles
- Research overview and highlights
- Fostering the ecosystem

Outlook
Exponential organizations: Outside-in vs. inside-out thinking
## Project network and project partners
Start-ups, Software & Data Providers, Investors, Big Players, …

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New network partners are welcome!
Contact: matthes@in.tum.de
Beiträge des TUM Living Lab Connected Mobility

Innovative Use Cases

TUM Living Lab Connected Mobility

Prototypen

Forschung & Entwicklung

Datenbank-Systeme

Verteilte Systeme

Security Engineering

Wirtschaftsinformatik

Anbieter Daten

Anbieter Mobilitäts-Apps

Anbieter Plattformen

Nutzer

Verbände

Politik

Startups

Forschungsprojekte

Anbieter Technologie

Vernetzung relevanter Akteure
Senior researchers

Prof. Dr. h.c. Manfred Broy
Software- and Systems Engineering Research Group

Prof. Dr. Fritz Busch
Lehrstuhl für Verkehrstechnik

Prof. Dr. Alfons Kemper
Lehrstuhl für Datenbanksysteme

Prof. Dr. Helmut Krcmar
Chair for Information Systems

Prof. Dr. Florian Matthes
Lehrstuhl Software Engineering for Business Information Systems (sebis)

Prof. Dr. Jörg Ott
The BMW–endowed Chair of Connected Mobility

Dr. habil. Christian Prehofer
Software- and Systems Engineering Research Group

Prof. Dr. Alexander Pretschner
Lehrstuhl für Software Engineering

Prof. Dr. Johann Schlichter
Lehrstuhl für Angewandte Informatik – Kooperative Systeme
Junior researchers (postdocs & PhD candidates)

- Ömer Uludag, Plattform & Ökosystem Governance
- Felix Michel, Partner On- & Off-Boarding
- Anne Faber, Crowdsourcing & Innovation
- Tanmaya Mahapatra, Service Mashups Entwicklungssupport
- Dr. Markus Böhm, Geschäftsmodelle Plattformanbieter
- Dr. Kristian Beckers, Accountability
- Amjad Ibrahim, Accountability
- Jorg Landmaier, Integriertes Monitoring Infrastruktur, Services & Business
- Martin Kleehaus, Visueller Service-Management Leitstand
- Vittorio Cozzolino, Sensing on Demand
- Michael Haus, Proximity Services
- Dr. Ilias Gerostathopoulos, Technische Plattform-Architektur
- Georgios Pipelidis, Modelle & Werkzeuge für Indoor-Karten
- Nihan Celikkaya, Umweltsensitives Verkehrsmanagement
- Sasan Amini, Verkehrsmanagement bei Großereignissen
- Daniel Herzog, Kollaborative & soziale Mobilitätsdienste
- Andreas Kipf, Integrationsplattform für temporale geographische Daten
- Varun Pandey, Geospital Big Data Exploration
Collaborative and Social Mobility Services

Mobile Event Recommendations

Intermodal Route Planning

City Trip Recommendations
Eco-Sensitive Traffic Management

**Reduction of Road Transport Emissions in Urban Areas:**

- **Air Pollutants**
- **Greenhouse Gases**
- **Noise**

Types of Emission Levels and Locations of Measurement Stations, adapted from M. Lutz stated in Air Quality Plan of City of Munich, 2006.
Models and Tools for Indoor Mapping

1. \( (x, y, z) \)
   Obtaining a reference location...

2. Clustering the traces based on time series...
   \( x(t) \in \{ x_0, x_1, x_2 \} \)

3. Segmenting those points based on their characteristics...
   \( y(x, y, z) \in \{ y_0, y_1, y_2 \} \)

4. Through context recognition, the semantics of a space can be emerged
   \[ a \cdot x + b = 0 \]

5. Can result to a geometric representation through points and polygons...

6. ...the user’s walking direction...

7. ...the user’s step length...

8. ...and environmental characteristics...

9. \( f(x, y, z) = a \)

10. Can result to a set of points with given characteristics.

11. Which finally can result to a map of the indoor space.
Private Proximity Services

**Big Picture**
- **Discovers**: Things relevant to you
- **Senses**: Your environment and motion
- **Learns**: Your preferences
- **Filters**: For things relevant to you
- **Knows**: You and what’s around you
- **Interacts**: With your surroundings

**Challenges**
- **Privacy**: Barriers to technologies that
- **Battery Life**: Always-on services require continuous discovery
- **Scale**: Long range and high capacity
- **Interoperability**: Proprietary platforms lead to mobile app silos

**Objectives**
- **Evaluation of different mechanisms to detect vicinity of users**
- **System architecture and implementation of several mechanisms for proximity detection**
- **Prototype to seamlessly group people based on environment data**
Integrate and exploit resources at the edge of the network to augment Cloud capabilities and optimize existing services.

Design a virtualization-based, on-demand sensing platform/framework.

Analyze how critical parameters (i.e., privacy, performances) are affected at scale in a multi-tenant environment.
HyPer: A Hybrid OLTP & OLAP Man Memory Database
Interactive Analytics on the New York City Taxi Dataset
Accountability Mechanisms

Conceptual and Technical Framework for **Accountability**

- Identification of unwanted behavior derived from legal, contractual, and self-imposed obligations at different layers
- Detect, document and reason about violations of requirements concerning security, safety and privacy

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**Defining accountability goals**

- Threat/hazard analysis
- System models
- Knowledge of anticipated unwanted behavior

**Evidence Collection**

- Log Requirements/ Templates
- Securing logs

**Causality Analysis**

- Correlation
- Counterfactual reasoning
- Semantic reasoning and mining

**Support Tools**

- Visualization
- Semantic expressiveness

---

**Secure Logging concepts**

- Hash-Chain Evolving Keys
- Batch-Aggregate
- Distributed protocol
Modeling and visualizing business ecosystems

Business Ecosystem Explorer
Discovering Insights In Business Ecosystems

Explore the ecosystem to gain insights using different interactive visualizations

Model the ecosystem to update others by including recent information

Click to add information regarding relation between Porsche and Capgemini

https://ecosystem-explorer.in.tum.de
New opportunities created via specifically designed collision-events

Invited Speaker

Research Project

New Venture

Industry Challenge

Spin-in

New Venture

Career Opportunity

Venture Lab Team

High Profile Venture

EIR or Investor with unique investment thesis

Student posters
hackaTUM 2016 / 2107
Lessons learned

Severe cultural clashes
- Startups, incumbents
- Industry, academia
- Good guys, bad guys (public transport, car manufacturers)
- Us, them (BMW employee selling train tickets?)

Lack of mobility data for research and innovation
- Legal constraints
- Lack of trust
- Lack of business models
Towards an open market of digital mobility services

The TU München Living Lab Connected Mobility

Outlook

- Legal regulations create a window of opportunity for new businesses
- Will Blockchain technologies enable a decentralized mobility ecosystem?
- Invitation for interdisciplinary collaboration
Legal regulations create a window of opportunity for new business models

**General Data Protection Regulation**
(EU GDPR enforceable in May 2018)
- Data portability
- Right to erasure
- Data protection by design and default
- Pseudonymity
- Right for explanation
- Consent (may be withdrawn)
- Data protection officer & sanctions

**Examples**
- Social media data
- Search engine usage data
- Health data, Genome data
- Personal mobility data

**Approaches to compliant data management**
- Adapt in-house software landscape
- Buy solution from standard software providers
- Use cloud-based data management services
  - Shared service center
  - Independent provider
  - Data cooperative

Data is the new oil ➔ Data is the new asbestos
Approaches to personal data management

Shared services

Shared data
[optional]

Individual services

Isolated data

Provider centered

Customer centered

Provider centered

Customer centered
Will blockchain technologies enable a decentralized mobility ecosystem?

**Today**
IT ecosystem based on technical APIs and encapsulated data

**Tomorrow?**
Business ecosystem based on shared contracts & data
Invitation for interdisciplinary collaboration

- TUM Living Lab Connected Mobility
- Projekt „Marktplatz der Daten oder Datengenossenschaften“
  Alternative nutzerzentrierte Betreibermodelle für Daten- und Dienstplattformen

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<thead>
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<th>Software Engineering</th>
<th>Plattformentwicklung</th>
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- Lexalyze – Informatics & Law
Prof. Dr.

**Florian Matthes**

Inhaber des Lehrstuhls

Technische Universität München  
Fakultät für Informatik  
Lehrstuhl für Software Engineering  
betrieblicher Informationssysteme

Boltzmannstraße 3  
85748 Garching bei München

Tel  +49.89.289.17132  
Fax  +49.89.289.17136  

matthes@in.tum.de  
www.matthes.in.tum.de