Tomorrow's Transport Infrastructure: From static to elastic mobility

TS080

Ilja Radusch, Fraunhofer FOKUS
Tokyo, October 17th 2013
Vision

Achieving always optimal mobility conditions.

Targeting

- Users: Encouraging collaborative behaviour of travellers and drivers.
- Infrastructure: Making infrastructures adapt pro-actively and in real-time based on user needs.
- Communication technologies: Combining automotive communication systems with cloud technologies.
Mission

Turn static into elastic mobility by balancing needs.

Collaboration is the key concept.
It extends the cooperative concept of vehicle-2-x systems to include interaction and participation.

Make travellers and drivers, vehicles and infrastructure act as a TEAM
  • Adapting to each other
  • Adapting to the situation
Motivation

Next: Collaboration integrates and balances all stakeholder needs.
Approach

Four paradigms define the research concept.

1. Elastic mobility
   means a shift from a reactive traffic management to an permanent adaptive and collaborative traffic management.

2. Window of interaction
   refers to the real time needs of human decision making process between 5 seconds and 5 minutes.

3. Participation
   considers the needs and behaviours of road users in the technical systems of intelligent transport solutions.

4. Collaboration
   extends the cooperative concept of vehicle-2-x systems by integrating the user into a highly interactive and participatory network.
Stakeholders

Stakeholders are essential for the key concept of collaboration.

TEAM uses stakeholders

- to detail use case identification, requirements and state-of-the-art analysis
- to establish a continuous dialogue to validate and improve designs and development
- to support the final evaluation
- to support deployment and exploitation

The stakeholders are

- car manufacturers
- suppliers
- telecommunication providers
- road infrastructure operators

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Infrastructure stakeholders’ involvement

Including major municipalities from the beginning.

**Finland** – Tampere and Helsinki

**Sweden** – Gothenburg

**Germany** – Berlin

**Italy** – Turin and Trento province

**Greece** – Athens and Trikala
User, stakeholders, and use cases

Selection Process

1. Collect
   Collection of mobility applications

2. Filter
   TEAM Character
   - Time to decision
   - Collaboration
   - Penetration and participation
   - Social welfare
User, stakeholders, and use cases

Projects scanned *

• DRIVE C2X, simTD
• SAFESPOT, SPITS
• INVENT, AKTIV, CODIA
• Vehicle Infrastructure Integration

Ongoing projects of interest were mainly the following:

• eCoMove
• INTIME, iTETRIS, citylog

* Selection
Selection Process cont.

3. Assess

- Technical assessment
  - Demo feasibility
  - Technical challenge
  - Impact assessment

- Stakeholder assessment
  - Business aspect
  - User acceptance
  - Mobility benefit
  - Throughput benefit
  - Environmental benefit
  - Safety benefit
  - Community benefit

TEAM applications
Applications

Infrastructure.

(1) Collaborative pro-active urban/inter-urban monitoring and ad-hoc control (CMC)
(2) Collaborative co-modal route planning (COPLAN)
(3) Co-modal coaching with support from virtual/avatar users (CCA)
(4) Collaborative smart intersection for intelligent priorities (CSI)
(5) Collaborative public transport optimization (CPTO)
(6) Collaborative dynamic corridors (DC)
User, stakeholders, and use cases

Stakeholder Survey

Traffic Throughput Benefit

<table>
<thead>
<tr>
<th></th>
<th>CMC</th>
<th>COPLAN</th>
<th>CCA</th>
<th>CSI</th>
<th>CPTO</th>
<th>DC</th>
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<td>8.20</td>
<td>8.67</td>
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User, stakeholders, and use cases

Stakeholder Survey

Mobility of Travelers

<table>
<thead>
<tr>
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User, stakeholders, and use cases

Stakeholder Survey

Community Benefit

<table>
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<tr>
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<td>7.54</td>
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User, stakeholders, and use cases

Stakeholder Survey

Safety Benefit

- CMC: 6.58
- COPLAN: 6.50
- CCA: 4.90
- CSI: 6.83
- CPTO: 5.28
- DC: 6.37
User, stakeholders, and use cases

Stakeholder Survey

End User Acceptance

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<tr>
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<td>7.17</td>
<td>8.53</td>
<td>6.84</td>
<td>8.07</td>
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User, stakeholders, and use cases

Stakeholder Survey

Business Case

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User, stakeholders, and use cases

Stakeholder Survey

Technology Challenge

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Users and stakeholders

Characteristics, preferences and constraints

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Preferences and constraints / Main targets</th>
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<tbody>
<tr>
<td>Users</td>
<td>Egoists: fastest, smoothest, most convenient route</td>
</tr>
<tr>
<td></td>
<td>• Congestion avoidance</td>
</tr>
<tr>
<td></td>
<td>• Improved bus services</td>
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<td></td>
<td>• En-trip information</td>
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<tr>
<td></td>
<td>• Decision support etc.</td>
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<tr>
<td></td>
<td>They don’t want to be monitored by the “system”</td>
</tr>
<tr>
<td>Road operators</td>
<td>• Safety (human and cost reasons)</td>
</tr>
<tr>
<td></td>
<td>• Sustainability of the road infrastructure</td>
</tr>
<tr>
<td>Public transport operators</td>
<td>Maximise quality of service and minimise their costs (conflicting)</td>
</tr>
<tr>
<td></td>
<td>• Priority scheduling / Green wave</td>
</tr>
<tr>
<td></td>
<td>• Dynamic bus lines, bus lines synchronisation etc.</td>
</tr>
<tr>
<td>Local authorities</td>
<td>Focused on their residents’ preferences</td>
</tr>
<tr>
<td></td>
<td>• Congestion reduction</td>
</tr>
<tr>
<td></td>
<td>• Modal split</td>
</tr>
<tr>
<td></td>
<td>• Access control</td>
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## Users and stakeholders

### Characteristics, preferences and constraints

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</table>
| **Traffic management centres**     | Efficiently manage the traffic to keep other stakeholders satisfied  
• Current traffic state & forecast, historic data  
• Reaction to incidents  
• Flow maximisation  
• Provide data to third party companies |
| **Automotive OEMs and suppliers**  | Real-time (traffic) information to the driver – competitive advantage  
• Equipment for gathering (traffic) information, providing this information to the TMC and receiving traffic information gathered by others |
| **Others**                         | **Logistics providers:** interested in post processed data from the TMCs for providing good services to their customers  
**Emergency vehicles:** they want to be as fast as possible while disregarding all constraints and preferences of all other stakeholders |
Elastic transport infrastructure requirements

Requirements groups & examples

Data and interfaces requirements
- The infrastructure shall be able to collect and process collaborative information received from equipped vehicles and travelers
- The infrastructure shall be able to integrate data coming from external providers/legacy systems

Data processing requirements
- The infrastructure shall apply data fusion techniques, aggregating data from all the available sources and estimating current traffic situation, providing information on traffic forecast and optimizing traffic flow by applying pro-active traffic control strategies
- The infrastructure shall be able to calculate alternative multi-modal routing solutions

Communication requirements
- The infrastructure shall be compliant to the available communication standards by ETSI and CEN/ISO
- The infrastructure shall use standardized interfaces and protocols to all communication partners (e.g. SIRI, TPEG, DATEX2)
Architecture and design concept

Layered design

Applications: application layer

Enablers (data, algorithms, tools): service layer

Relevant work

Other projects: DRIVE C2X, etc.

Standardisation: ETSI ITS communication architecture, etc.
Conclusion & future work

Conclusion

• TEAM collaborative network – A key concept for addressing transport problems of modern cities
• Promising results from the stakeholders survey for future deployment and exploitation
• Innovative applications selected (stakeholders survey)
• Work related to the requirements and the architecture of elastic transport infrastructure

Future work

• Specifications of applications and enablers for elastic mobility
• Complete architecture and design
The end

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