Seamless traffic data dissemination across urban and inter-urban networks

SEAMLESS

27/09/2013
Vienna
1. AlbrechtConsult (consortium coordinator)

2. PTV

3. Mott MacDonald

4. TrafficMaster
Partner AlbrechtConsult

- Specialised in all aspects of ITS architecture
- Distributed systems, interfaces and interoperability
- Urban and inter-urban domain
- Open Traffic Systems City Association (OCA)
- In SEAMLESS: migration path from current landscape of traffic management systems towards an open, distributed architecture
- Projects:
  - simTP: Support of the City of Frankfurt/Main in providing the Urban part of a large Field Operational Test
  - Mobility Data Marketplace: innovative concept for an electronic marketplace for traffic and transport data
  - DATEX II: leading the Expert and Study Group on data exchange in the EasyWay programme
Partner PTV

- Software solutions for traffic management
- Leading provider of products and solutions for travel, traffic and transportation planning
- Cutting-edge software technology and consulting to enable customers to meet their mobility needs
- Traveler and consumer information
  - manage traffic and transportation
  - traffic reports
  - optimizing long-term resource allocation
- Know-how:
  - data acquisition from different sources (stationary and floating car)
  - data fusion and data management
- In SEAMLESS: provide extensive knowledge of both the market and the research perspective of traffic management systems and cooperative systems
• Transport technology services:
  – traffic management systems
  – communications design
  – data management and analysis
  – travel information systems

• In SEAMLESS:
  – Experience on the full range of inter-urban and urban traffic systems interfaces and data distribution issues
  – deep technical experience on harmonisation of protocols
  – awareness of emerging research on in-vehicle traffic management

• Projects:
  – Leeds UTMC – delivery of traffic management systems integration platform; integration of ITS components including VMS and website
  – Halogen – provides information services from the national roads infrastructure
  – ITS Metadata Registry – repository and process for data exchange specifications; has contributed to harmonisation & improvement of data dissemination protocols including DATEX II.
Partner TrafficMaster

- Live traffic data, collection, processing and dissemination
- Most established private sector traffic data service provider
- Traffic data quality and dissemination expertise
- Over 4 million customers in the UK
  - radio broadcast (RDS-TMC and DAB-TPEG)
  - internet feeds
  - interactive phone services
  - mobile apps
  - web services
- Customers: car makers, mobile network operators, UK government, motoring organisations, mobile phone and portable navigation companies
- Participation in working groups for the UK’s Digital Radio Action Plan and the EC’s ITS Directive
- TMC/TPEG standards development work conducted through TISA
SEAMLESS – an ERA-NET ROAD project

The Story

Traffic Management

„Traditional“
SEAMLESS

The Story

Cooperative Systems

„Innovative“

„Traditional“

Traffic Management

SEAMLESS – an ERA-NET ROAD project
The Story

Cooperative Systems

"Innovative"

The Challenge

"Traditional"

Traffic Management

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The Story

• Wake up call for traditional Traffic Management: Cooperative Systems and Data Dissemination are coming!
  – new technologies
  – new infrastructure
  – new players
  – maybe even new mindset

• Two strong and proud communities – who takes care of connecting the two worlds?
The Story

Traditional Service Chain

Delivery Channels

- Cable from stationary detector
- Cellular Networks: 2G, 3G, 4G
- WIFI/WLAN: IEEE 802.11p

Event, Traffic situation

- Analogue Radio: VHF/FM RDS
- Digital Radio: DAB, DAB+, etc.
- Cellular Networks: 2G, 3G, 4G
- WIFI/WLAN: IEEE 802.11p
- Cable to VMS
- Ethernet to Web Side

Detection Content Collection

- Proprietary (from det)
- CAM (vehicle)
- GATS (no longer in use)

Content preprocessing

- proprietary
- DATEX II

Info-Service provision

- RDS-TMC
- TPEG
- DENM (vehicle)
- Proprietary (to VMS)
- Proprietary (to Web)

Info-Service presentation

End User

What is spared here - for the sake of simplicity - are the Location referencing standards, which is a big issue, too.
The Story

Possible influence of Cooperative Systems and Data Dissemination

Need of public data for private services or vice versa
Possible influence of Cooperative Systems and Data Dissemination

Input from a variety of different (distributed) sources
Possible influence of Cooperative Systems and Data Dissemination

Services for a variety of different service providers and end-user channels
The Story

Possible influence of Cooperative Systems and Data Dissemination

Use of different channels for the same data origin and receiver
A lot of Test Fields for Cooperative Systems

And yes if you scratch the surface there are efforts to connect legacy (somewhere in the Annex ...)

- Often bespoke/proprietary solutions which do not survive the end of the project
- Few (no?) use of standards
- There is a gap!
Project ‘SEAMLESS’

- “Prepare traffic data dissemination that works seamlessly across urban and inter-urban networks”
- Main topics
  - Data dissemination to in-vehicle systems
  - Link to cooperative systems
  - Linking Legacy
The Challenge

Road authorities must make best use of existing road capacity and keep track of:
- Rising traffic demand
- Environmental challenges
- Economical feasibility

Road authorities have recognised the growing importance but also the huge potential of intelligent infrastructure.

Challenges in distributing road authority data to travellers:
- Not all data available (with public funding?!) reaches travellers (e.g. due to administrative problems)
- Road authorities are seeking to reduce their dependency on bespoke roadside infrastructure for traffic management
• Lots of money was invested

But results are poor

• New technology-channels are to come up

But even new channels have no content, if back end data exchange does not work

Lack of seamless services
Seamless Services

Research and Development
Cooperative Systems

Current Service Provision

Traffic Management („Legacy“)

Seamless Services
Results of SEAMLESS

- Overview about existing research
- Analysis of business cases
- Developing a Generic architecture
- Multiple Mappings between standards (UTMC / OCIT to ETSI)
- Harmonisation of protocols and data profiles
“Analysis of existing research on road data dissemination to in-vehicle devices”

Analysis of existing research
- Summarized 42 projects in total with respect to Cooperative Systems
- Description of standards
- Stakeholder and their objectives
- Description of Use Cases
• Huge number of standardisation and business development activities
• Work of TISA as well as of ETSI/CEN will influence the future market
• Innovation-oriented activities are mainly based on
  – COMeSAFTEY (consolidation the outcomes of the research projects)
  – CVIS/SafeSpot/Coopers (basic technology oriented results)
  – SimTD and Drive C2X (most relevant field operation tests (FOT))
• Introduction of new services must be based on sound migration strategy

Furthermore:
• EU-wide know-how and orientations have been incorporated into SEAMLESS by the Deployment Guidelines (in form of knowledge from more than 140 road operators)
Existing research

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Advantages of new data-exchange cooperations

Road Operators:
- Direct communicate with the driver
- Better acceptance of the measures

Car Manufactures:
- Improvement of vehicle safety systems
- Driver information and efficient engine control

Service Providers:
- Commercial distribution of data and information

Appropriate organizational arrangements needed for cooperation – for example Mobility Data Market Place
Focus on long period operation without losing quality
Business structures must be in line with all technical and organizational aspects

Cost savings, quality improvement of information
Business Case Considerations

- Private information providers and the automotive sector have realised the need for improved cooperation between (urban) public authorities and industry.

- BUT: ‘Unlocking’ public data is cost intensive!
  - legacy systems (different level of implementation, different hardware structure, different data structures, ...)
  - often small coverage of multiple authorities
  - not always free of charge
  - data existence not even always known

- As a result, only the most valuable sources are used

- Suggestions:
  - Data is released to the commercial providers ‘free of charge’ using a simple model
  - contract with few if any restrictions on data re-use
  - Data should be available from all sources in one (or a minimum set of) agreed common formats (for example consolidated DATEX II profiles)
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ITS Services

Structural composition of ITS Services

IT layers, not ITS! (basically not part of SEAMLESS)

Strategy
Processes
Information structures
IT services
IT infrastructures

Time for Development, Maintenance and Improvement

Concretisation: Instantiation

IT infrastructures

Complexity
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Generic Architecture

- **Strategy**
- **Processes**
- **Information structures**
- **IT services**
- **IT infrastructures**

**Concretisation:** Instantiation

**Time for Development, Maintenance and Improvement**

**Complexity**
• Architecture model for C-ITS
  – Generic nature
  – Adapting existing architectures (ETSI, CVIS, ..)
  – Focus on linking legacy systems
  – Base for modeling tailored reference architectures
    for different use cases (e.g. traffic light phase assistant, journey times, ..)
<table>
<thead>
<tr>
<th>Service Providers</th>
<th>Road Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Layer</td>
<td></td>
</tr>
<tr>
<td>Central Layer</td>
<td></td>
</tr>
<tr>
<td>Mobile Layer</td>
<td></td>
</tr>
</tbody>
</table>
Service Providers

Road Operators

Legacy Systems

Central ITS-station

Vehicle Service Backend
Roadside backend

Vehicle ITS-station
Personal ITS-station

Sensors

Roadside ITS-station

Vehicle Services
Infrastructure Services

Traffic Management

Roadside backend

Central ITS-station

Vehicle Service Backend

Mobile Layer

Field Layer

Central Layer

Peer to peer connection based on mobile networks

Digital Broadcast (unidirectional)

ITS G5

ITS G5

Peer to peer connection based on mobile networks
Hybrid communication

• Service Providers
  – want to deliver their information through a dedicated channel
  – want to set their services apart from other service providers
  – do not feel unhappy when controlling both ends of the channel
    (e.g. bespoke solution on customer side)

• Road Operators
  – are interested in complete and coincident information on
    customer side and
  – consistent data deliveries
  – like to use more than one channel to get a wider information
    spread and to compensate channel constraints
Example Mapping to UTMC

Service Providers
- ICS: ITS Central Station
- IVS: ITS Vehicle Station
- IMS: ITS Mobile Station
- IRS: ITS Roadside Station
- DATEX II

Road Operators
- Traffic Management
- Roadside Backend
- Vehicle Service Backend

Key:
- ICS: ITS Central Station
- IVS: ITS Vehicle Station
- IMS: ITS Mobile Station
- IRS: ITS Roadside Station

Legend:
- Node B: Traffic management centre
- Node C: Outstation
- Node D: Controlled unit
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Use Cases

Time for Development, Maintenance and Improvement

Concretisation: Instantiation

Complexity

IT infrastructures

IT services

Information structures

Processes

Strategy
Use Case

Example Traffic Light Phase Assistant
Traffic Light Phase Asst.

- Different architectures possible
  (direct communication via Field Layer, Central routing, ...)

- Different communication channels
  (digital or local broadcast, peer to peer, ...)

- Different Data Models
  (type and amount of data to transfer differs a lot)

- Different channel characteristics
  (Latency, Bandwidth)

- Different applications
  (Real time prognosis, routing, eco-driving, ...)

All of these Points influence each other!
Traffic Light Phase Asst.

- Roadside ITS station is raising questions
  - Where is it placed physically?
  - Multifunctional approach
    (like \(\text{sim}^{TD}\), with framework and applications)
    \(\text{sim}^{TD}, \text{CVIS paradigm: adding elements at runtime}\)
  - “Plug-in” for Traffic light controller
    (intended by manufactures of traffic light controllers
    \(\rightarrow\) more complex data handling inside the controller necessary)

- And even more
  - Own radio module for every application?
  - Will OCIT-O need to transport FCD data? (in fact, this is planned)
  - New controlling methods/software necessary?! (also think of budget approaches regarding Public Transport)

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Lots of unregulated activities

Questions are the same as for inter-urban systems!
DATEX II profiles and mappings

Harmonisation of protocols

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SEAMLESS results on the **traffic light** use case

- DATEX II model and profile for traffic light information
- DATEX II model and profile for traffic management plans
Data model for TMPs and navigation systems
• UML Profile, tailored to the use case in question
• Selecting appropriate attributes and literals from DATEX II „Level A“
• Adding custom extensions („Level B“)
• XSD schema
• Documentation
• Example files (XML)
Harmonisation of protocols

- SEAMLESS results on **traffic information** use case
  - Improved travel time & traffic condition profile
  - XML Schema defining travel time & traffic condition profile (like seen before on Traffic Light Use Case)
  - Comment on CEN 16157-5 (Variable Message Signs)
  - Improvement issues with DATEX II
  - Comment on TPEG TFP
  - UTMC Guidance – Publishing traffic information
  - Guidance on translation of DATEX II travel times and traffic events to TPEG.

Now showing
Example DATEX II to TPEG

Here: Travel times and traffic status (translation to TPEG TFP)
Same exists for traffic events (translation to TPEG TEC)
Comparison:
EasyWay Deployment Guideline TIS-DG03-05 vs. DATEX II (no distinction in TPEG TFP)

<table>
<thead>
<tr>
<th>EasyWay travel time types</th>
<th>DATEX II enumeration literals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instantaneous Travel Time (ITT)</td>
<td>best</td>
</tr>
<tr>
<td>Output Rebuilt Travel Time (ORTT)</td>
<td>estimated</td>
</tr>
<tr>
<td>Estimated Travel Time (ETT)</td>
<td>instantaneous</td>
</tr>
<tr>
<td>Mixed Travel Time (MTT)</td>
<td>reconstituted</td>
</tr>
<tr>
<td>Forecast Travel Time (FTT)</td>
<td></td>
</tr>
</tbody>
</table>
# Example DATEX II to TPEG

<table>
<thead>
<tr>
<th>TPEG TFP concept</th>
<th>DATEX II-TPEG translation notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>freeflowTravelTime</td>
<td>from freeflowTravelTime</td>
</tr>
<tr>
<td>delay</td>
<td>difference between travelTime and freeflowTravelTime</td>
</tr>
<tr>
<td>averageSpeed</td>
<td>Represented by TrafficSpeed::averageVehicleSpeed, but this is not in the DATEX II travel times profile.</td>
</tr>
<tr>
<td>LOS (level of service)</td>
<td>from combination of trafficStatusValue and trafficTrendType (if published, else the translation will need to look at the previous value to determine the trend)</td>
</tr>
</tbody>
</table>

**status**
- freeflow -> free traffic
- heavy -> heavy traffic
- congested -> queuing traffic
- impossible -> no traffic flow
- unknown -> unknown

**trend**
- trafficBuildingUp -> "increasing" i.e. codes 17-20
- trafficEasing -> "decreasing" i.e. codes 26-30
- trafficStable -> "constant" i.e. codes 9-14
- unknown -> "Tendency: unknown" i.e. codes 0-6
SEAMLESS showed how to translate urban traffic management system information (DATEX II) for subsequent presentation to motorists (TPEG) for traffic status and traffic events.

Based on UTMC urban traffic systems (i.e. not all parts of DATEX II or TPEG are covered).

UDG (UTMC Development Group) can be asked to add extensions to UTMC to cover all mandatory TPEG elements.

DATEX II is capable to cover the bridge between UTMC and TPEG without lack of information.
• Amount of data is increasing, its audience as well
• Data today is still not always accessible in a satisfying way
→ Danger of reducing interest in new technologies
→ New Opportunities go along with new risks of wrong handling

• SEAMLESS showed how to merge architectures from R&D and FOT on existing urban systems
• SEAMLESS showed that OTS and UTMC can be mapped to C-ITS architectures
• SEAMLESS showed variants for the open question of best allocation for R-ITSS (same problem for urban than for inter urban)
Thank you for your attention

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