Vehicular networking for road safety and traffic efficiency: Trento Test Site

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DRIVE C2X: Field Operational Test on cooperative systems

- Co-funded by European Commission DG connect, FP7
- Coordinated by Daimler
- January 2011-June 2014
- 34 partners, 7 Test Sites
- OEM’s: Opel, Audi, Daimler, FIAT, Ford, Renault, PSA, Volvo, plus YAMAHA, HONDA, BMW as associated
- Italian Test Site “Brennero”, Trento
  FIAT Research Centre
  Autostrada del Brennero – A22
Concept: Information shared among vehicles and infrastructure

Example: Helmond Test Site (DITCM)
Traffic Light Message, on FIAT vehicle display

Source: DRIVE C2X EU project

Vehicles
- 802.11p comm.
- Positioning
- Vehicle data access
- V2V-V2I Applications
- UMTS connectivity

Roadside stations
- 802.11p comm.
- V2I applications
- Ethernet connectivity
- Roadside sensors

Source: DRIVE C2X EU project

Example: Helmond Test Site (DITCM)
Traffic Light Message, on FIAT vehicle display

Source: DRIVE C2X EU project
V2V, V2I communication: basic concept

Cooperative Awareness Message (CAM)
- Sender node presence & status: e.g. car position, speed, brake, headlights status, etc.
- Recipient combines CAM data with own data, e.g. car sensors, to infer situation

Decentralized Environmental Notification Message (DENM)
- Sender node warning, e.g. “traffic jam ahead”, and warning validity data: area affected, priority, etc.
- Can be forwarded (geo-networking)
- Intended recipient displays DENM warning content on car display based on message validity data

Image from: A22 video, DRIVE C2X test environment
DRIVE C2X reference system on FIAT cars

Main components:
Communication Control Unit, CCU
Application Unit, AU
Validation of reference system @ DITCM previous to Test Site Italy experiments

The Dutch Test Site (DITCM) allowed the evaluation of the DRIVE C2X reference system by using an independent system.

All OEM’s and equipment suppliers participated to the tests.

Objective: to validate DRIVE C2X vehicle, infrastructure and service centre back-end in view of the deployment in the other test sites, including Italy.

Source: TNO, DRIVE C2X
OEMs and suppliers working on V2X in Europe: testing of functions and use cases

<table>
<thead>
<tr>
<th>Tested in Italy</th>
<th>Developed by CRF</th>
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<tbody>
<tr>
<td>• In vehicle signage</td>
<td>• Wrong Way Driving in Gas Stations</td>
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<td>• Car breakdown warning</td>
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<tr>
<td>• Approaching emergency vehicle</td>
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<td>• Road works warning</td>
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<td>• Traffic jam ahead warning</td>
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<td>• Wrong way driving</td>
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<td>• Slow vehicle warning</td>
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<td>• Motorcycle approaching</td>
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<td>Tested in the Netherlands and Sweden</td>
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<td>• Weather warning</td>
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<td>• Obstacle on the road</td>
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<td>• Pedestrian crossing</td>
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<tr>
<td>• Green Light Optimal Speed Advisory</td>
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</tbody>
</table>

Field Operational Tests

Demonstration

Validation

Tested in Italy

- In vehicle signage
- Car breakdown warning
- Approaching emergency vehicle
- Road works warning
- Traffic jam ahead warning
- Wrong way driving
- Slow vehicle warning
- Motorcycle approaching

Tested in the Netherlands and Sweden

- Weather warning
- Obstacle on the road
- Pedestrian crossing
- Green Light Optimal Speed Advisory
Focus on Test Site Italy, Trento

- 10 km along A22 motorway, 2 lanes per direction
- 10 running vehicles
- 5 roadside stations
- Service Centre
- Precise GNSS (RTK)
Test Site Italy: integration with Service Centre

Italian Test Site Service Centre within Autobrennero Centre, Trento

Test Management Centre
Data collection and monitoring

Specific Test Site Component
- Provide TS specific data
- Allow TS manager to configure UC

Legacy systems
(e.g. databases, interfaces outside DRIVE C2X specifications)

- RIS Application Unit #1
- RIS Application Unit #2
- RIS AU #...

Local/remote Test operator (@ CRF/A22)

Roadside sensors

VMS

Vehicle

UMTS

G5

RIS CCU #1

RIS CCU#2

RIS CCU#...
Summary: involvement of TS Italy/A22/CRF

- Interoperability Tests, the Netherlands, September 2012
- Technical tests, A22, Yamaha HONDA, March-May 2013
- DRIVE C2X@TSS demo, Sweden, June 2013
- Tests with end-users, A22, September-October 2013
- DRIVE C2X Demo by CRF @EUCAR, Bruxelles, November 2013
- End Users Focus Group, Trento, December 2013
Conclusions

- Test site for OEM’s and road providers to assess their applications in real, free-flow scenarios. Functions have been tested through a fleet of equipped vehicles.

- Focus: 802.11p/ITS-G5 data reception on I2V alerts by roadside infrastructure.

- Strong influence of specific environment and installation, variance of hundreds of metres (300m-1000m), depending on Line of Sight.

- Overall such range, together with low latency (50ms), is suitable to preventive safety and traffic efficiency applications.
Expected evolution of Test Site Trento

- Extension of Trento Test Site up to Verona (90 km south)
- Inclusion of urban and extra-urban scenarios
- Addition of intersection-related applications (both V2V and V2I)
- Addition of accurate digital maps
- Enhancement of Test Site tools for data management and test operation monitoring
- Cloud-based applications enabled by LTE/4G
Test Site “Brennero” in Trento, Italy, provided by Autostrada del Brennero and Centro Ricerche FIAT, CRF

Field Operational Test in collaboration with Yamaha and Honda
Functions in Trento Test Site provided by CRF, Ford, Honda, Opel, Fraunhofer FOKUS

within DRIVE C2X project, www.drive-c2x.eu
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(*=support partner, §=third party)