Introduction to the DRIVE C2X Integrated Project

Overview on the project

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On behalf of DRIVE C2X consortium
Vehicular communication in the past

- First serious attempt on vehicular communication in PROMETHEUS (1986 – 1994)
  - Project COPDRIVE
    - Radio location and communication.
    - Exchange of intention of maneuvers and of actual maneuvers.
    - No GPS!
  - Project focus changed later to registration and communication of warning messages.

Technological deficits unfortunately enforced abandonment of these activities.
## Technology situation then and today

<table>
<thead>
<tr>
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<th>Situation then (1990’s)</th>
<th>Situation today (2010’s)</th>
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<tbody>
<tr>
<td><strong>Positioning</strong></td>
<td>Lack of suitable positioning system; GPS not available for civilian use</td>
<td>Free availability of GPS worldwide with sufficient accuracy; EGNOS/Galileo as European alternative being deployed</td>
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<tr>
<td><strong>Communication</strong></td>
<td>Lack of cheap and powerful radio modules; mobile communication just taking off</td>
<td>WLAN as commodity enables cheap modules for dedicated communication; GSM and 3G available everywhere</td>
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<td><strong>Computing</strong></td>
<td>PC became increasingly popular but not suitable for vehicular application for lack of computing power and robustness</td>
<td>Powerful PC based solutions and embedded solutions available at reasonable costs</td>
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<td><strong>Actuation systems</strong></td>
<td>Penetration rate of anti lock brakes slowly taking off</td>
<td>Anti lock brakes and ESC standard in majority of new vehicles, ACC and others increasingly popular</td>
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<td><strong>In-vehicle data networks</strong></td>
<td>Very few vehicles with CAN bus CAN standard in all new vehicles, often complemented by Flexray, MOST, LIN</td>
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<td><strong>Standardisation</strong></td>
<td>• Visionary ideas and tremendous enthusiasm but technological means missing</td>
<td>• Technological basis available</td>
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<td></td>
<td>• Further research in basic technologies needed</td>
<td>• System concept proven in various research projects</td>
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<td>• Time to prepare Europe-wide deployment</td>
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</table>
What is needed now?

- Evaluation of the common European system in field trials on several places in Europe to:
  - Verify proper functioning in real life conditions
  - Foster Europe-wide interoperability
  - Agree on use cases for early deployment
  - Assess the impact of the various use cases
- Completion of standardisation
- Commonly agreed implementation strategy and realistic business cases
- Common deployment decision of all stakeholders involved

The DRIVE C2X project plans to address these issues by organizing a European wide large scale tests
DRIVE C2X objectives

- Carry out a **comprehensive assessment** of cooperative systems through extensive **European Field Operational Tests**.
- Create and **harmonise a European wide testing environment** for cooperative systems.
- **Coordinate the tests** carried out on parallel throughout the DRIVE C2X community.
- **Evaluate** cooperative systems.
- **Promote** cooperative driving.
Functions to be evaluated in DRIVE C2X

- The functions to be tested and evaluated on several European test sites for cooperative systems are related to:
  - Traffic flow
  - Traffic management
  - Local danger alert
  - Driving assistance
  - Internet access and local information services
  - Test site-specific functions to be defined independently by each test site.
### List of Use Cases under consideration

#### Road safety Use Cases
- Roadworks warning
- Car breakdown warning
- Stop sign violation
- Traffic jam ahead warning
- Approaching emergency vehicle
- Slow vehicle warning
- Right-turn collision warning
- Post crash warning
- Curve speed warning
- Emergency electronic brake lights
- Hazardous location notification
- Slow vehicle notification
- Signal violation warning
- Lane departure warning
- Co-operative forward collision warning
- Obstacle Warning
- Weather Warning
- Wrong Way driving

#### Traffic Efficiency Use Cases
- In-vehicle signage
- Regulatory and contextual speed limit
- Limited access warning
- Traffic information and management
- Decentralized traffic management
- Greenlight optimal speed advisory
- Enhanced route guidance and navigation
- Adaptive drivetrain management
- Co-operative flexible lane allocation
- Co-operative adaptive cruise control
- Co-operative merging assistance
- Co-operative forward collision warning
- Obstacle Warning
- Electronic toll collect
- Map download and update
- Instant messaging
- Design Re-Use and Change Management
- Remote diagnosis and just in time repair notification

#### Infotainment and Commercial Backend Use Cases
- Remote personal data synchronization
- Fleet management
- Car rental / sharing assignment / reporting
- Local electronic commerce
- Media downloading
- Automatic access control / parking management
- SOS service
- Electronic toll collect
- Map download and update
- Instant messaging
- Design Re-Use and Change Management
- Remote diagnosis and just in time repair notification
- Business Intelligence for High-Volume Service Parts
- Ecological driving
- Dealer Management
- Transparent Leasing

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**Final list of supported DRIVE C2X Use Cases under preparation**

Only a limited subset of functions will be assessed in DRIVE C2X

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**Project start date:** 01.01.2011 | **End date:** 31.12.2013

**etsi tc its workshop, venice**

**Introduction to DRIVE C2X**
Principles of test site use and testing

System test site (STS)
- Main test site with reference DRIVE C2X implementation
- All selected DRIVE C2X use cases will be tested on the STS
- Technical validation of the FOT system including the collection of data
- Thorough interoperability testing with all OBU vendors and OEMs
- Full scale interoperability test planned by Jan 2012
- Formal feedback to ETSI on lessons learned

Functional Test Sites (FTS)
- Test sites linked to national activities
- Subset of functions common to all test sites
- Uses a local test management center to execute selected use cases
- Vehicles and RSUs provided by site operator
- Use of a pool of DRIVE C2X vehicles as reference for interoperability testing
- One test site is dedicated to harsh winter conditions testing
- Test subjects are “normal driver”
- FTS operation to last up to 8-10 months
DRIVE C2X Test Sites

Seven Test Sites:
- System Test Site:
  - Helmond/Eindhoven, The Netherlands
- Functional Test Sites:
  - Tampere, Finland,
  - Yvelines, France,
  - Frankfurt, Germany,
  - Brennero, Italy,
  - Gothenburg, Sweden
  - Vigo, Spain
## Time planning

<table>
<thead>
<tr>
<th>Start Date</th>
<th>Event Description</th>
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<tr>
<td>January 2011</td>
<td>Kick-Off</td>
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<tr>
<td>August 2011</td>
<td>First basic DRIVE C2X tests on Helmond Test Site</td>
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<tr>
<td>January 2012</td>
<td>Full scale test of enhanced DRIVE C2X FOT system on Helmond test site</td>
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<tr>
<td>March 2012</td>
<td>Adaptation of all Function Test Sites ready</td>
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<tr>
<td>Summer 2012</td>
<td>All Functional Test Sites piloted and ready for data collection</td>
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<tr>
<td>Sept 2012 – June 2013</td>
<td>All data collected for assessment of benefits</td>
</tr>
<tr>
<td>December 2013</td>
<td>Assessment completed</td>
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DRIVE C2X in the cooperative driving activities context

- PReVENT, EASIS, NoW, GeoNet, ITETRIS etc.
  - Harmonised architecture

- SafeSpot
  - Safety use case

- C2C-CC
  - Scenarios & use cases for vehicular communication
  - Basic services

- COMeSafety
  - ITS architecture

- ETSI TC ITS
  - Common European Standard for ITS

- FESTA
  - FOT methodology
  - Research questions

- FOT-Net
  - FOT Network
  - Methodology improvement

- PRE-DRIVE C2X
  - C2X use cases
  - Function implementation
  - C2X OBU & RSU
  - Test management

- DRIVE C2X is European-wide
  - Large scale testing
  - Impact assessment
  - Interoperability of systems
  - Deployment preparation

- European test sites
  - Helmond, NL
  - Hessen, D
  - Versailles, F
  - Brennero, IT
  - Tampere, FI
  - Gotoborg, S
  - Galicia, E

- euroFOT, TeleFOT
  - FOT experience
  - Data analysis
  - Data collection experience

Project start date: 01.01.2011 | End date: 31.12.2013
Standardization

WP55 Standardization (DAI BMW HIT NEC)

- Analysis of DRIVE C2X system for standard compliance
- Recommendations to DRIVE C2X component developers
- Contribution to ETSI TC ITS Working Groups (comments, change requests)
- Feedback from ETSI TC ITS standardization

DRIVE C2X

COMeSafety

- Communication architecture
- International harmonization of standards

Cooperation

- Verify the compliancy of DRIVE C2X components with existing standards
- Provide feedback to standardization for systems tested within DRIVE C2X. Evaluate impact of current standards on networking, facilities and applications.
- Provide further inputs to COMeSafety’s Communication Architecture description (process to be defined)

09-11.02.2011 \ 12
ETSII TC ITS Workshop, Venice
Introduction to DRIVE C2X

Project start date: 01.01.2011 | End date: 31.12.2013
Project partners

44 Partners – among which 11 support partners (non-funded)

Automotive OEMs

Electronics and supplier industry, telcos
- Continental *, Delphi Delco Electronics Europe GmbH, Denso Automotive Deutschland*, FT – Orange Labs*, Hitachi Europe SAS, NEC Europe Ltd., Renesas Technology Europe GmbH, Robert Bosch GmbH*, Vector*

Software developers
- SAP AG

Traffic engineers
- ptv AG

Research institutes
- BAST, Centro Tecnológico de Automoción de Galicia*, Chalmers University, DLR, EICT, ERTICO, Facit Research, FhG FOKUS, INRIA, IMEC, Karlsruhe Institute of Technology, Technische Universität Graz, TNO, Universitatea Tehnica Cluj-Napoca, University of Surrey, VTT, HTW Saarland*

Road Operators
- Autostrada del Brennero, City of Tampere*, Hessische Straßen- und Verkehrsverwaltung

Others
- Nokian Renkaat*, German Insurance Association

* Support members

Project start date: 01.01.2011 | end date: 31.12.2013
Project data

- **Budget / Funding:** 18.920 m€ / 12.400 m€
- **Start date / End date:** 01.01.2011 / 31.12.2013

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