V2X standardization and deployment: viewpoint of a system provider

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Lan LIN
lan.lin@hitachi-eu.com
Information and Communication Technologies Laboratory (ICTL), FRANCE
Outlines

• Background
• V2X deployment
• Standardization and main technical features
• ICTL activities on V2X and beyond.
Background

• Intelligent Transport System (ITS) targets at:
  • Road safety
  • Traffic efficiency
  • Environmental effects
  • Comfort and mobility

• Modern society and industries are living some transformations:
  • Connected lifestyle, even in the car
  • Social networks
  • Multimodal mobility
  • Smart cities

→ Cars will interact with their environment in many different ways
→ New stakeholders in the value chain
→ Approaching of consumer industries and automobile industries
Fact sheet: Road safety

The Commission’s Road Safety Programme aiming at cutting road deaths in Europe between 2011 and 2020.

• Road Safety is a major societal issue. In 2011, more than 30,000 people died on the roads of the European Union.
• For every death on Europe's roads there are an estimated 4 permanently disabling injuries.
Fact sheet: Vehicle connectivity

Telematics:
• Telematics shipment is foreseen to reach 30 millions at 2017 in western Europe
  • Aftermarket devices and OEM embedded/hybrid devices are having equivalent share.
  • The penetration rate is estimated to reach more than 90% at the same time scale.

Vehicle safety system:
• ADAS Overall Value World Market is increasing rapidly and the trend seems continue
• Connectivity based safety systems will be deployed in EU and in world wide:
  • eCall directive in EU.
  • ITS G5 technologies in EU/DSRC in USA/ITS spot services in Japan

Vehicle and infrastructure integration:
• Infrastructure service provision based on I2V (Infrastructure to Vehicle) to further stimulate the penetration rate.
• ITS in smart cities, smart energy management.
What is C2X?

Cooperative System by Car-to-Car and Car-to-Infrastructure Communications for Traffic Safety and Efficiency, and for Automotive Infotainment:
- Various communication media and protocols
- Multiple applications/services
- Open platform

C2C: Car to Car
C2I: Car to Infra

**Public Sectors**
- Traffic Centers
- Traffic info
- Probe data

**Private Sectors**
- Service Stations
- Service info
- Vehicle Status

**VEHICLES**
- Motorcycles
- Cars
  - Position
  - Speed

**INFRAs**
- Traffic Lights
- Road Signs
- LTE 4G
Cooperative ITS (V2X) systems

5,875 – 5,905 (ITSG5A/ITSG5B) spectrum has been allocated in EU for road safety and traffic efficiency application. However, C-ITS may use other technologies such as cellular, WLAN.

ITS G5 technologies:
- Quick media access $\rightarrow$ low latency communication
- Ad hoc communication $\rightarrow$ no infrastructure requirements
- Allocated spectrum for ITS $\rightarrow$ communication reliability
- 200-800m communication range $\rightarrow$ extended view for vehicle compared to RADAR, LIDAR

ITS G5 is considered as main candidate for road safety applications by European C2C-CC

V2V V2I deployment will stimulate the deployment and penetration rate.

Source: ETSI

C2C-CC: car to car communication consortium
ITS station communication architecture

ETSI TC ITS modular architecture, supporting
- Multiple applications
- Multiple communication protocol
- Multiple access technologies

- ITS vehicle station
- ITS road side station
- ITS central station
- ITS personal station

Source: ETSI
Pave the road for deployment

Car makers in C2C-CC have signed a MoU for volunteer deployment from 2015 on.

- Application effectiveness evaluation, impact to real traffic, user acceptance...
- Standard compliance, performance validation, system integration.
- Interoperability and harmonization.
- Minimum requirements.
- Strategic support.

FOT: Field Operational Test
V2X applications

- V2X extends the view of radar based proactive or active safety.
- Technology agnostic
- But application requirements may result in specific choice of technologies:
  - Reliability
  - Communication coverage
  - Latency
  - Interoperability

Source: ETSI
Deployment and penetration rate

- V2V based applications required a minimum penetration rate.
  - C2C-CC estimates that 10% is required for V2V safety
  - Critical for reaching critical mass in installed base
    - Only 14 million vehicles sold / 250 million installed base
- Retrofit solution and/or smartphone based system may stimulate further the penetration rate
- Other factors:
  - Infrastructure based applications
  - Infotainment applications

Penetration rate

- Factory installed V2X (15 years life cycle)
- Retrofit and smartphones V2X (5 year life cycle)
Standardization: essential part of ITS

Standardizations (or amendment of current standards) is essential, with the regulation on spectrum usage.

• Communication interoperability
  • Communication protocol stack.
    • Access (PHY MAC)
    • Networking & transport
  • Standardized message exchanges
    • Message format, high layer protocol

• Modularity:
  • To enable multiple implementation strategy.
  • Layer base architecture and protocol design.

• Performance:
  • Basic performance requirements:
    • Data quality, information availability, congestion

• Compliance and testing
  • Standardized test specifications are required.

• Certification and testing:
  • Standard compliance testing
  • Interoperability testing
  • System performance compliance assessment

Source: DRIVE C2X
Standardisation environment for ITS

Guidance/Consolidation

- CAR 2 CAR
- COM Safety
- Safety Forum

R&D Projects

Specification

ETSI

Standardisation

Collaboration

ISO

Harmonisation

IEEE

ETSI TC ITS - CEN TC278/ISO TC204

23 Nov 2010

CAR 2 CAR Forum 2010
ETSI Standardisation activities – M/453

ETSI TC ITS

- WG1 Application requirements
- WG2 Architecture and cross layer
- WG3 Network and transport
- WG4 Media and media dependent
- WG5 Security

C2C TC

WG APP

WG ARC

WG COM

WG SEC

Reporting to the European Commission


23 Nov 2010

CAR 2 CAR Forum 2010
Main technical features and standards

- Periodical broadcasting vehicle position and basic sensor information up to 10Hz.
- Traffic event message
- Traffic light phase and timing information
- Road topology information
- Road signage information
- Service announcement
- Local dynamic maps database
- Position and time information
- HMI supports
- Vehicle CAN bus gateway
- Other high layer protocol (web service, SOAP, HTTP)

- Geo position based addressing and routing
- Legacy IP stack
- Transmission of IP over GeoNet

- Dynamic selection of communication profile
- Network and media congestion control

- Certificates update with PKI
- Communication security mechanism
- IP security

Source: ETSI
ICTL Introduction

**ICTL – Information and Communication Technologies Laboratory**

8 people, 7 researchers

Sophia Antipolis – FRANCE

**Samsung** and **Intel** recently opened R&D sites on Sophia as well

<table>
<thead>
<tr>
<th>Phase</th>
<th>Exploration – Maturation</th>
<th>Research/Development – Business Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topics</td>
<td>Wireless Communications, Ad Hoc Networks</td>
<td>Vehicular Comms (C2X*)</td>
</tr>
</tbody>
</table>

*C2X: Car to Any  **ITS: Intelligent Transport Systems*
C2X activities in EU

2005-2009 2010 2011 2012 2013 2014-

Standardization
Standard mandate 453
Profiling standards

Technical Validation
R&D Phase EU/National FOTs* Phase Piloting Phase

ICTL plays important roles in the C2X community

ICTL in Standardization
ETSI ITS Tech Committee
WG1 (Application): Co-chair
WG2 (Architecture)
WG3 (Networking): Editor
WG4 (Media)
WG5 (Security)

ICTL in EU/National FOT* Projects
Steering Committee Member
SP1 (Pj Mngmt)
SP2 (Specs): Leader
SP3 (FOT)
SP4 (Evaluation)
SP5 (Promotion)

FOT prototype

*FOT: Field Operational Test  *ITS: Intelligent Transport Systems  *MoU: Memorandum of Understanding
**C2X Comm. Platform developed by ICTL in FOTs**

**General scenario**

- **C2I Comm.** (Signal phase, etc.)
- **C2C Comm.** (Vehicle info.)
- **OBU (On-Board Unit)**
  - **Speed Advisory**: Go w/ 40km/h
  - **T to Green**: 8s
  - **Collision Risk**: Approaching Car on left!

**C2X platform technologies to analyze surrounding info. in real-time**

- **Local Dynamic Map (LDM)**
- **C2X Protocol**
- **Sensing**
- **C2X Info.**

**Applications**

**ECUs**

**RSU**

**Traffic Signal**
C2X Technologies by ICTL

ICTL Develops advanced functions of C2X geoNetworking protocol

Advanced Forwarding Protocols

Area-based Multihop Broadcast

Transmission Interval Control (TIC)

Spatially-stabilize NW usage

Stable NW Usage

Packet Density

Vehicle Density

PHY/MAC*

PHY: Physical Layer  MAC: Media Access Control  TPC: Transmission Power Control  GBC: Geo-broadcast

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DRIVE C2X project overview: 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

Supported by

Collaboration partner

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## DRIVE C2X project overview: Use cases

<table>
<thead>
<tr>
<th>Safety</th>
<th>Traffic Efficiency</th>
<th>Infotainment and Business</th>
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</thead>
<tbody>
<tr>
<td>Traffic jam ahead warning</td>
<td>In vehicle signage/ Speed limit</td>
<td>Insurance and financial services *</td>
</tr>
<tr>
<td>(BSA: Traffic condition warning)</td>
<td>[ ]</td>
<td>Dealer management*</td>
</tr>
<tr>
<td>Roadworks warning</td>
<td>Green light optimized speed advise</td>
<td>Point of interest notification</td>
</tr>
<tr>
<td>Car breakdown warning</td>
<td>(BSA: Traffic light optimal speed advisory)</td>
<td>Fleet management*</td>
</tr>
<tr>
<td>Approaching emergency vehicle</td>
<td>(BSA: Emerg. vehicle warning)</td>
<td>Transparent leasing*</td>
</tr>
<tr>
<td>Weather warning</td>
<td></td>
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<tr>
<td>Emergency electronic brake</td>
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<tr>
<td>lights</td>
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<tr>
<td>Slow vehicle warning</td>
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<tr>
<td>(BSA: slow vehicle indication)</td>
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<tr>
<td>Post-crash warning</td>
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<tr>
<td>(BSA: Stationary vehicle-accident)</td>
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<tr>
<td>Obstacle warning</td>
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<tr>
<td>Wrong way driving in gas</td>
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<tr>
<td>stations</td>
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<tr>
<td>Motorcycle warning</td>
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<tr>
<td>(BSA: Motorcycle approaching indication)</td>
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</tbody>
</table>

- Use cases in green are listed in ETSI BSA.

- Safety applications are under standardization

* currently pending
Reference systems developed in DRIVE C2X:
VIS (Vehicle ITS station) integrated with in vehicle network.
RIS (Road ITS station) interfaced with road side sensors and equipment's.
CIS (Center ITS station): including management center, test center, and DRIVE C2X PKI.

Hitachi is the provider of V2X platform reference system for DRIVE C2X and for SCORE@F. The V2X platform is validated in ETSI plug test.
Usage of C2X technologies in eCo-FEV*

EU Smart Mobility Project for EV-infrastructure cooperation

<table>
<thead>
<tr>
<th>Period</th>
<th>September 2012 – May 2015</th>
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</thead>
<tbody>
<tr>
<td>Partners</td>
<td>Hitachi (ICTL is Coordinator), Renault, Fiat + 10 organizations</td>
</tr>
</tbody>
</table>
| Goals           | • To develop a standardized platform  
|                 | • To exploit infrastructures’ info for advanced EV cloud services |

* eCo-FEV: Efficient Cooperative Infrastructure for Fully Electric Vehicles
Aim of eCo-FEV project

**Current Issues**
- Smart Mobility City is realized through the coordination of different infrastructures.
- But each infrastructure is working separately.

**Project Aim**
To define a platform to enable information exchanges between multiple infrastructures for more organic ITS services for EV

**EV**: Electric Vehicle
Thank you

Lan.lin@hitachi-eu.com