Cooperative ACC
R&D, standardization and roadmap

Hitachi Europe SAS.
Automotive and Industry Laboratory (A&IL)
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Andrea TOMATIS (Deputy Lab Manager)
Lan LIN (ETSI TC ITS WG1 chair)

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1. Hitachi Group’s social innovation business

Serving the World with Our Social Innovation Business

SOCIAL INNOVATION – IT’S OUR FUTURE

“IT” × “Social infrastructure”

- Energy
- Cities
- Transportation
- Healthcare
- Resources (e.g., water)
- Logistics
- Manufacturing and construction
- Finance
2. Hitachi’s vision for automotive

We developed many technologies, products, and solutions satisfying our Customers.

We are global Service Provider using our IT technologies.

We develop Connected Car Services for Autonomous Cars.
3. A&IL R&D activities

On Going Activities

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2009</td>
<td>GeoNet</td>
</tr>
<tr>
<td>2010</td>
<td>Drive C2X &amp; SCORE@F</td>
</tr>
<tr>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>eCo-FEV, Autonet2030</td>
</tr>
<tr>
<td>2015</td>
<td>Automotive Big Data</td>
</tr>
</tbody>
</table>

ADASIS for Automated Driving

Cooperative Comms capability

Cooperative Automated Driving
4. C-ITS standardization for connected automated driving

- Standards ensure communication interoperability by commonly defined communication protocols
- Interoperability between stakeholders' IT systems can be reached, thanks to harmonized standardized architecture, and standardized data exchange interfaces
- Standards define performance requirements for future autonomous driving vehicles

<table>
<thead>
<tr>
<th>WI</th>
<th>Title</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR 102 638</td>
<td>Use case description</td>
<td>draft</td>
</tr>
<tr>
<td>TR 103 299</td>
<td>C-ACC pre-standardization study</td>
<td>Draft</td>
</tr>
<tr>
<td>TR 103 298</td>
<td>Platooning pre-standardization study</td>
<td>Initiated</td>
</tr>
<tr>
<td>TR 103 300</td>
<td>Vulnerable road user pre-standardization study</td>
<td>Initiated</td>
</tr>
<tr>
<td>TS 103 301</td>
<td>I2V message protocol</td>
<td>Stable draft</td>
</tr>
<tr>
<td>TS 103 324</td>
<td>Cooperative object sensing</td>
<td>Initiated</td>
</tr>
<tr>
<td>TS 103 152</td>
<td>Multimedia data transmission</td>
<td>Draft</td>
</tr>
<tr>
<td>TS 101 559-2</td>
<td>Tyre pressure information system – tyre pressure gauge communication</td>
<td>Draft</td>
</tr>
<tr>
<td>TS 103 141</td>
<td>Facilities layer DCC</td>
<td>Stable draft</td>
</tr>
<tr>
<td>TS 101 539-2</td>
<td>Intersection collision risk warning</td>
<td>Stable draft</td>
</tr>
<tr>
<td>TS 102 890-3</td>
<td>POTI</td>
<td>Draft</td>
</tr>
</tbody>
</table>
5. TR 103 299 - C-ACC pre-standardization study

• **TR 103 299 is:**
  • A pre-standardization study
  • Definition, use cases, requirements, recommendation on technical specifications.
  • Targeting at extending the release 1 standards (CAM, DENM, GN, ITS G5 etc.) to support C-ACC applications
  • Analysis standardization needs

• **The Work Item:**
  • Is initiated by ETSI TC ITS with support of C2C-CC members
  • Is targeting at international harmonization via e.g. collaboration With SAE TC DSRC and with ISO TC204 WG14.
6. TR 103 299 - C-ACC current draft status 1

- **CACC** is:
  - An in-vehicle driving assistance system that adjusts the vehicle speed to keep a desired time gap with preceding vehicle (target vehicle) to improve driving comfort, reduce fuel consumption, improve road capacity, etc.
  - At least a level 1 automated system, and may participate to higher level automation level system.
  - an « upgraded » ACC: ACC is one operational mode of CACC

**Multiple CACC use cases:**
- **UC001**: Follow the target vehicle at configured target time gap
- **UC002**: Follow the target vehicle at automatically adjusted target time gap
- **UC003**: Single lane of CACC string with more than 3 CACC vehicles
- **US004**: Co-operation of steering control and CACC
7. TR 103 299 - C-ACC current draft status 2

- **CACC architecture definition:**
  - From multiple viewpoints: information viewpoint, functional viewpoint, architecture viewpoint.
  - Consider multiple stakeholders and service scenarios

1: V2V based CACC

2: V2V based CACC with road side support (e.g. advisory speed, road curve etc.)

3: V2V based CACC “managed” by road side e.g. specific lane assignment, target time gap etc.
## 8. Standard extensions – AutoNet2030 proposition

**EN 302 637-2** (cooperative awareness) published version

**CAM:** high rate heart beating message for cooperative ITS.

### Table: CAM Content

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
<th>Transmission Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving Mode</td>
<td>The driving mode engaged by the vehicle that sent the CAM.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Automated Control</td>
<td>Lists the automated vehicle control systems engaged by the vehicle that sent the CAM.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Braking Capacity</td>
<td>The maximum braking capacity and its confidence of the vehicle that sent the CAM.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Target Speed</td>
<td>The target speed of the vehicle that sent the CAM.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Target Longitudinal Acceleration</td>
<td>The target longitudinal acceleration of the vehicle that sent the CAM.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Target Distance to Preceding Vehicle</td>
<td>The target distance between the front bumper of the vehicle that sent the CAM and the rear bumper of its preceding vehicle in the same lane.</td>
<td>10 Hz</td>
</tr>
<tr>
<td>Target Distance to Following Vehicle</td>
<td>The target distance between the rear bumper of the vehicle that sent the CAM and the front bumper of its following vehicle in the same lane.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Predicted Path</td>
<td>The predicted future trajectory of the vehicle that sent the CAM.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Group Identifier</td>
<td>The platoon of convoy identifier in which the vehicle that sent the CAM is driving.</td>
<td>2 Hz</td>
</tr>
<tr>
<td>Group Speed</td>
<td>Target speed of the convoy or platoon the vehicle is driving in</td>
<td>2 Hz</td>
</tr>
</tbody>
</table>
9. Conclusion: pave the road to automation

Please join us in standardization efforts

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

Pre engineering & Certification
Large scale FoTs and evaluation
Prototype, test & validation
Standard and international standards harmonization
Applications and system performance requirements
ITS action plan& directive, legal framework, industrial consortiums, European standard mandate

Please join us in standardization efforts
Thank you for your attention

Andrea TOMATIS

A&IL – Centre of Social Innovation
Hitachi Europe SAS.
Sophia Antipolis, France
andrea.tomatis@hitachi-eu.com