V2V Advancements in the last 12 months

CAMP and related activities

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Connected Transportation Environment: Future Vision
Opportunities
Would enhance existing obstacle detection-based driver assistance systems
Would allow new features not possible with existing obstacle detection-based driver assistance systems, including control features with redundant on-board sensing

Challenges
Requires other vehicles and/or infrastructure to be equipped
Security requires periodic vehicle connection to an off-board system

The initial focus in the US is to use V2X technology for crash-imminent safety applications.
CAMP provides an OEM oriented administrative shell under which various stakeholders can collaborate on pre-competitive crash avoidance research projects of mutual interest.
Vehicle-to-Vehicle (V2V) Overview

V2V uses DSRC (ITS-G5) and GPS to enable wireless real-time communication between vehicles to notify driver of potential hazards.

**J2735 Basic Safety Message:**

- **Information Transmitted**
  - Random Vehicle ID, Sequence #, Time Stamp, Position (latitude, longitude, elevation, accuracy),
  - Motion (speed, transmission state, heading angle, brake, accel/decel),
  - Control (yaw rate), &
  - Vehicle Size (length, width)

**Security Credentials**

DSRC = Dedicated Short Range Communication

V2V technology could enhance existing obstacle detection-based driver assistance systems.
Potential V2V Applications – Forward Collision Scenarios

V2V applications which may enhance the current “forward collision” driver assist technologies that rely primarily on “line-of-sight” sensing.
Potential V2V Applications – Cross-Path Collision Scenarios

- Intersection Movement Assist
- Left Turn Assist
- Right Turn Into Path

V2V applications which may reduce “cross-path” collision risk.
A key enabler for V2V is the Security “Back-End” which develops the security certificates required for vehicles to authenticate the message between each other along with providing misbehavior reporting and revocation mechanisms.

Security will require a new paradigm. For vehicles to provide feature operation, they will require periodic security updates while in service.

SCMS = Security Credential Management System
The Crash Avoidance Metrics Partnership, or CAMP for short, is focused on addressing the technical challenges with V2V and V2I. Automakers and the government are working to address key policy issues through the Vehicle Infrastructure Integration Consortium (VIIC).
General Requirements for Interoperability

**Required for Deployment:**
Different Manufacturers

– Communicating on the Same Frequency
  → Where do we go to talk

– Using the Same Language
  → We understand each other
  → Data in messages meets same minimum requirements

- With Security
  → We trust what we say to each other

- Managing Channel Loading
  → We vary message frequency and power together

**Same Frequency: 5.9 GHz DSRC (IEEE 1609.4)**

**Control Channel**

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</tr>
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<tbody>
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</tr>
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<td>Ch 182</td>
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<td>Ch 184</td>
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</tbody>
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**Same Language**

(IEEE 802.11p)

**WAVE Short Message (IEEE 1609.3)**

**Basic Safety Message (SAE J2735)**

- Basic Vehicle State
  (Veh. ID, Seq. #, time, position, motion, control, veh. size)

  *Mandatory in Basic Safety message*

**Vehicle Safety Extension**

- Event Flags
- Path History
- Path Prediction
- RTCM Corrections

*Required for V-V safety applications*

Other optional safety-related data

**Security (IEEE 1609.2)**
CAMP V2V Safety Research Initiatives

- Collaborative efforts between CAMP VSC3 Consortium and US DOT
  - V2V Model Deployment
  - V2V Security Studies
  - V2V Interoperability
    - Communications Scalability
    - Misbehavior Detection Research
    - Provision for testing spectrum sharing proposals

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Intelligent Transportation Systems

Virginia Tech Transportation Institute

DENSO North America

AUTOMOTIVE EVENTS
### CAMP V2V Model Deployment Safety Applications

<table>
<thead>
<tr>
<th>OEM/Applications</th>
<th>Ford</th>
<th>GM</th>
<th>Honda</th>
<th>Mercedes</th>
<th>Toyota</th>
<th>Hyundai-Kia</th>
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EEBL: Emergency Electronic Brake Lights  
FCW: Forward Collision Warning  
BSW/LCW: Blind Spot Warning/Lane Change Warning  
DNPW: Do Not Pass Warning  
IMA: Intersection Movement Assist  
LTA: Left Turn Assist
CAMP Model Deployment Summary

- Built and maintained sixty-four integrated light vehicles (ILV) for Safety Pilot Model Deployment. ILVs interacted with other vehicles sending BSMs, such as Vehicle Awareness Devices (VADs).

- MD data was used by NHTSA as part of their benefits analysis and by OEMs for V2V safety application development.
New CAMP Projects with NHTSA

**V2V**
Ford, GM, Honda, Hyundai-Kia, Mercedes, Nissan and VW/Audi

- Systems Engineering – finish V2V profile
- Security - Build and test prototype system for V2X
- Objective Test Procedures for IMA and LTA

**Automated Vehicle Research**
Ford, GM, Mercedes, Nissan, Toyota and VW/Audi

- Developing safety requirements and objective test procedure approaches for the various automation levels
New CAMP Projects with FHWA

Ford, GM, Honda, Hyundai-Kia, Mercedes, Mazda, Nissan, Subaru, VW/Audi and Volvo Truck

- V2I Safety, such as cooperative intersection safety
- Cooperative Adaptive Cruise Control
- Data Capture and Management for Dynamic Mobility Applications
- Road Weather Management
- Applications for the Environment: Real-Time Information Synthesis (AERIS): Eco Approach and Departure