Vehicle Infrastructure Integration and Effectiveness of Vehicle Safety Communications Applications

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The Big Picture

• What are the biggest safety problems that are appropriate for DOT involvement and appear to be solvable?

• To what extent can advanced technologies address these problems?
Our Research Process

1. Identification and Definition of Services
2. Selection of Services for Development
3. Performance System Design and Development
4. Operational Tests and Evaluations
5. Product Deployment

Gov't Role

Industry Role
The New Initiatives

- ACAT
- IVBSS
- CICAS
- VII / EVSCA
Background

Two interrelated projects:

- Vehicle Infrastructure Integration (VII)
- Effectiveness of Vehicle Safety Communications Applications (EVSCA)
Background - VII

- The VII Program is an Intelligent Transportation System (ITS) Tier-1 Initiative for electronically connecting vehicles and the infrastructure via a nationwide communication infrastructure (using DSRC\(^1\)).

- This new infrastructure will enable many safety applications.

\(^1\) Dedicated Short Range Communications @5.9GHz
Problem Definition

• EVSCA is a program to determine if safety applications that utilize DSRC can improve upon the performance of autonomous vehicle-based systems, enable communications-based-only safety applications.

• DOT has conducted extensive research on the effectiveness of vehicle-based collision countermeasures.

• However, the systems have inherent shortcomings that reduce their effectiveness. (e.g. alert timing and false alerts)

• Communications may enable improved system effectiveness by complementing or replacing vehicle-based sensors.
Program Purpose

**Overall Goal:** To accelerate introduction of VII and the Vehicle-based Driver Assistance Safety Systems into the Nation’s vehicle fleet.

**Objectives:**

- Develop objective estimates of safety impact for cooperative-applications that address rear-end, road-departure, lane-change crashes.
- Perform the tasks necessary to prepare one of more cooperative active safety applications for inclusion in the VII FOT. Emergency Electronic Brake Lights (EEBL\(^1\)) is envisioned as one of the first applications tested.
- Continue the partnership between the U.S. DOT and the automotive OEMs (via CAMP and the VIIC) involving a wide range of stakeholders
- Facilitate introduction and commercialization of effective VSCA.

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1 EEBL’s objective is to provide early notification to the host vehicle of an emergency braking event (e.g. -0.6 g deceleration) occurring downstream in traffic, even when the drivers line-of-sight is obstructed by other vehicles.
Quantify the Problem

The most predominant crash type is a rear-end collision; accounting for ~29% of all crashes.

• Based on ‘02 GES, rear-end crashes accounted for 29% (1,798,000) of all “police-reported” crashes. Based on ‘02 FARS, rear-end crashes comprised 5% (1,900) of all “fatal” crashes.

• Results of the ACAS FOT indicate that an integrated FCW and ACC system has the potential to prevent 10-26% of all rear-end crashes.

• Shortcomings: 44% of the crash imminent alerts issued by the ACAS were due to out-of-path targets.
Quantify the Problem

Another crash type is the off-road crash where one or more vehicle leaves the roadway.

• Based on ‘02 GES, off-road crashes accounted for 23% (1,437,000) of all “police-reported” crashes. Based on ‘02 FARS, off-road crashes accounted for 42% (16,000) of all “fatal” crashes.

• Results from the RDCW FOT indicated that warning systems can prevent ~50% of these crashes.

• Shortcomings: LDW availability varied with road type, from 76% on freeways to 36% on non-freeways. LDW availability also varied with lighting and weather, from 56% during dry days to 4% during wet nights. CSW availability was consistently high, over 95% in most conditions.
Program Teams

**VI I**
- Government: NHTSA, ITS J PO, FHWA, and Volpe
- Support: BAH: System Integrator, RSU development, and Network Development
- Industry: VII Consortium (**VIIC**)
  - 5 Members: Ford, Nissan, BMW, Honda, DCX
  - Design of In-Vehicle Equipment

**EVSCA**
- Government: NHTSA, ITS J PO, FHWA, and Volpe
- Industry: Collision Avoidance Metrics Partnership (**CAMP**)
  - 5 Members: GM, Ford, DCX, Honda, Toyota
  - Develop Communications-based Vehicle Safety Applications
Roadmap - EVSCA

EvSCARoadmap

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**Task 1**
- **Target Crash Scenarios**

**Task 2**
- **Identify Safety Applications**
- **System Design & Application Test-Bed Development**

**Task 3**
- **Develop and Demonstrate Test Procedures**
- **Examine & Validate Applications**
- **Analyze Data & Estimate Benefits**

**Task 4**
- **Prototype System**
- **Prototype Vehicle**
- **Driver Vehicle Interface**
- **Experimental Design**
- **Objective Test Procedures**
- **Measures of Performance & Specifications**
- **Laboratory Tests**
- **Test Track Study**
- **Simulation Study**

**Task 5**
- **Performance Measures**
- **Safety Benefits**
- **Driver Acceptance**
- **Deployment Plan**

**Task 6**
- **List of Applications**
- **Preliminary Test Procedures for Review**
- **Complete Application Development**

Potential activities within each task for US DOT’s EVSCA program:
- Address Rear-End and Road Departure Crashes
- EEBL, Curve Speed Warning
- Target Crash Problems
- Data Mining
- Generate Scenarios
- Prototype System
- Prototype Vehicle
- Driver Vehicle Interface
- Experimental Design
- Objective Test Procedures
- Measures of Performance & Specifications
- Laboratory Tests
- Test Track Study
- Simulation Study
- Performance Measures
- Safety Benefits
- Driver Acceptance
- Deployment Plan

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EVSCA Program Plan / Approach

The EVSCA Program consists of six tasks:

Task 1: Identify target crash scenarios & critical events, Determine shortcomings of vehicle-based systems from FOT and other sources

Task 2: Identification of Safety Applications that might benefit from inclusion of communications.

Task 3: System Design and Application Test-Bed Development

Task 4: Develop performance specifications and test procedures

Task 5: Examine and Validate Applications, Conduct Verification testing

Task 6: Analyze Data and Estimate Benefits (w/ VOLPE)

Duration of Initiative

Estimated to be 3 years: FY06-FY09
EVSCA Status

• **Project Status**
  - Agreement negotiations / SOW development

• **2006 Milestones**
  - Finalize Cooperative agreement
  - Begin Tasks 1, 2, & 3
Funding

ITS Funding

- **Total Funding** – $8.9M
  - Federal share (80% - $7.1M)
  - Partner share (20% - $1.8M)

- **Annual Funding**
  - 2005 - $750K
  - 2006 - $3.1M (planned)
  - 2007 - $3.2M (planned)

- **Procurement Status**
  - Negotiations between NHTSA and CAMP continue to finalize of Cooperative agreement
Issues for both VI I and EVSCA

Programs must be closely coordinated with CICAS-V