

CAMP

Vehicle Safety Communications 2 Consortium

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Research and Technology North America, Inc.



Intelligent Transportation Systems

Vehicle Safety Communications – Applications

VSC-A

Kick-Off Briefing

Outline

- Introduction
- Objectives
- Research Activities and Timeline
- Technical Activities
- Major Milestones
- Major Deliverables

Introduction

- 3 year project - December 2006 to November 2009.
- Collaborative effort between 5 OEMs (DCX, Ford, GM, Honda & Toyota) and US DOT (+ Volpe & Mitretek).
- Goal: Determine if DSRC @5.9 GHz & vehicle positioning can improve upon autonomous* vehicle-based safety systems and/or enable new communication-based safety applications.
- Follow-on project to CAMP/DOT VSC (2002-2004) project and CAMP internal EEBL** project.
- Strong emphasis on resolving current communication and vehicle positioning issues so that interoperable future deployment of DSRC+Positioning based safety systems will be enabled.

* The word 'autonomous' is used to indicate that no cooperation from other vehicles or the infrastructure is required .

** Emergency Electronic Brake Lights

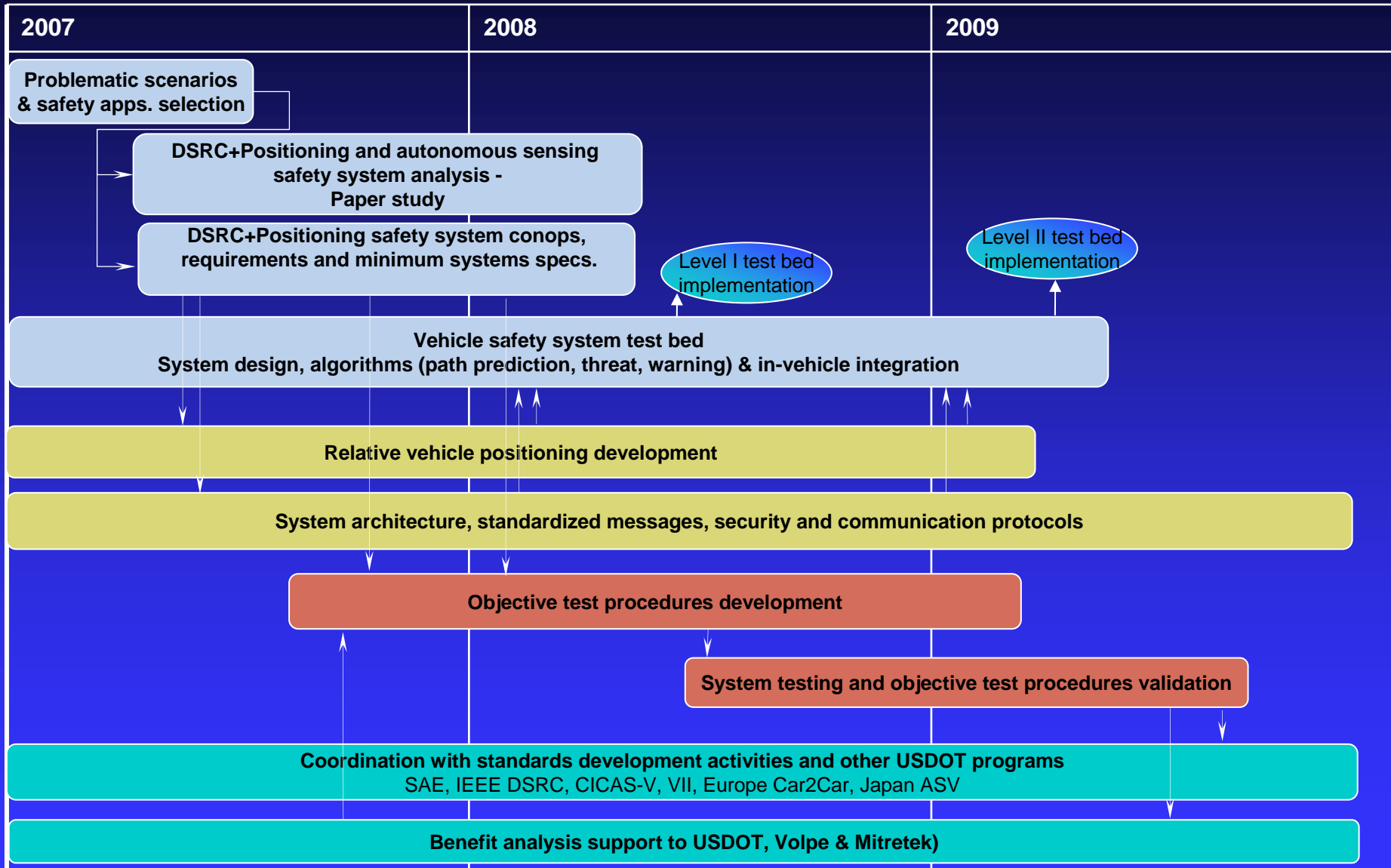
Objectives

1. Assess how previously identified critical safety scenarios in autonomous systems could be addressed and improved by DSRC+Positioning systems.
2. Define set of DSRC+Positioning based vehicle safety applications and application specifications including minimum system performance requirements.
3. In coordination with NHTSA and VOLPE, develop a well understood and agreed upon benefits versus market penetration analysis, and potential deployment models for a selected set of communication-based vehicle safety systems.

Objectives - continued

4. Develop scalable, common vehicle safety communication architecture, protocols and messaging framework (interfaces) necessary to achieve interoperability and cohesiveness among different vehicle manufacturers. Standardize this messaging framework and the communication protocols (including message sets) to facilitate future deployment.
5. Develop accurate and affordable vehicle positioning technology needed, in conjunction with the 5.9 GHz DSRC, to support most of the safety applications with high potential benefits.
6. Develop and verify set of objective test procedures for the vehicle safety communications applications.

VSC-A Research Activities and Timeline



VSC-A System Development Activities

- Develop system concepts of operation.
- Develop system requirements and minimum performance specifications.
- Develop, implement and evaluate:
 - ◆ An interoperable and scalable VSC systems architecture that would enable future deployment.
 - ◆ A common DSRC communication architecture and protocols to address channel loading and common integration of DSRC features.
 - ◆ DSRC message sets and protocols for VSC-A applications and standardization under SAE.
 - ◆ A practical and deployable solution for VSC-A system security & privacy.
- Develop an affordable and reliable vehicle relative positioning to support VSC-A system features.

VSC-A Communications Activities

- Develop system architecture, communication architecture, standardized messages and protocols:
 - ◆ Messaging scheme.
 - ◆ V-V Security:
 - ☞ *Privacy verses Authentication.*
 - ☞ Security Overhead.
 - ☞ Certificate Authority (coordination of best practices with VIIC, IEEE 1609.2, etc.).
 - ☞ Certificate Revocation (coordination of best practices with VIIC, IEEE 1609.2, etc.).
 - ◆ Characterizing reception performance as a function of transmission power.
 - ◆ Message dissemination strategies.
 - ◆ DSRC WAVE Standards Validation for Safety Applications.
 - ◆ Channel 172 usage.
 - ◆ International Trends.

VSC-A Positioning Activities

- *Preliminary Evaluation of GNSS Data Sharing Approaches:*
 1. V2V messaging with vehicle position information only.
 2. V2V messaging using 'pseudo reference station' data.
 3. V2V messaging with limited GNSS raw data.
- *Select an approach based on:*
 1. Relative position solution accuracy.
 2. Solution availability.
 3. Communication bandwidth demand.
- *Relative Position Solution Development for "Open Sky".*
- *Enhanced Relative Positioning Solution Incorporating GPS & DR.*
- *FL Camera Vehicle Positioning Aiding.*
- *System Performance Evaluation and Testing.*
- *White Paper on GPS Receiver Technology Enhancement.*

VSC-A System Test Bed

- System design:
 - ◆ Algorithms Development
 - ☞ Path prediction (based on host vehicle sensor info and other vehicle path history or "breadcrumbs")
 - ☞ Threat assessment,
 - ☞ Threat Prioritization
 - ◆ Engineering DVI
- In-Vehicle system integration
 - ◆ Prototype vehicle purchase & build
 - ◆ OBE acquisition (same OBE as in CICAS-V project)
 - ◆ OBE software & hardware customization/upgrade
 - ◆ OBE integration
 - ◆ System implementation
 - ◆ Functionality testing

VSC-A System Test Bed

- VSC-A System will consist of multiple safety applications running simultaneously.
- Initial list consists of:

Safety Features	Applicable NHTSA Crash Categories
Emergency Electronic Brake Lights (EEBL)	Rear-end crashes
Stopped Vehicle Ahead Warning (SVA)	Rear-end crashes
Blind Spot and Lane Change Warning (LCW)	Lane change crashes
Forward Collision Warning (FCW)	Rear-end crashes
Pre-Crash Sensing and Collision Mitigation (PCS & CM)	Crash mitigation
Curve Speed Warning (CSW)	Road departure crashes
Do-not-pass Warning	On-coming crashes
Intersection Movement Assist	Intersection crashes

- Final list of safety applications will be jointly finalized with USDOT by the end of May 2007. Down-selection to a manageable number of applications (~6) will be part of the process.
- No DVI optimization or Human Factors work is planned as part of this project – Only engineering DVIs are planned.

VSC-A System Objective Test Procedures

- Work will be done in conjunction with the NHTSA/Volpe/Mitretek.
- Task will start after the system definition is complete.
- Test procedures for DSC+Positioning only based system will be studied.
- Tests procedures will include test track and real world driving scenarios.
- Existing procedures will be used if applicable and new ones will be developed if necessary.

VSC-A System Testing And Objective Test Procedures Validation

- A Test Plan based on the Objective Test Procedures will be developed.
- The output of this work will include the test results, data and analysis.
- This is the final VSC-A system verification stage before providing a unified recommendation for standardization of the DSRC communication protocols and messages.
- This activity will be performed in conjunction with the NHTSA/Volpe/Mitretek.
- UDOT/Volpe/Mitretek are welcome to witness the tests.

VSC-A Current Activities

- List of problematic scenarios for autonomous sensing vehicle safety systems is being refined with DOT, Volpe and Mitretek.
- Initial list of safety applications is being reviewed for potential additions:
 - ◆ Need to finalize the list by May 2007.
 - ◆ Need to agree to start on a subset of safety applications soon:
 - ☞ EEBL
 - ☞ FCW and LCW/BSW for their high potential safety benefits (VSC I) and their more complex and representative communication and positioning requirements.
- Communications:
 - ◆ Detailed work plan is being prepared.
 - ◆ Technical WGs being formed & coordination with VII-C IPT security initiated
 - ◆ Security workshop for Feb. 22 & 23 at CAMP is set.
- Positioning: RFQ for V-V GPS positioning being reviewed by the VSC-A technical team.
- Standards:
 - ◆ SAE OEM presence within DSRC vehicle safety subcommittee is being increased.
 - ◆ Standards support plan is being developed.
- Other DOT Programs: VSC-A coordination with CICAS-V and VII POC.

VSC-A Major Milestones

January 2007	List of initial critical target scenarios identified by NHTSA from earlier research and FOTs
May 2007	VSC-A team and NHTSA jointly finalize list of safety applications for VSC-A system
November 2007	Task 5 Interim Report – Initial system concept, minimum specifications, message composition, security and vehicle positioning
February 2008	System concepts of operation and minimum system performance requirements.
May 2008	VSC system level I implementation
January 2009	Objective Test Plan defined
March 2009	VSC-A system level II implementation
November 2009	Final Project Briefing and Report – project ends.

VSC-A Major Deliverables

In addition to the Quarterly Briefings, the Quarterly Status and Financial Reports and the Annual Reports, the following table summarizes the list of deliverables for this project

VSC-A activity	Deliverable	Due Date
Program Management	Research Plan	2/07
Standards and Other DOT Programs	Support Plan	3/07
	Interim Report	11/07
	Interim Report	11/08
VSC and Autonomous Safety Systems	Interim Report	8/07
VSC System Definition	Interim Report	10/07
DSRC+Positioning and Autonomous Sensing Safety System Analysis - Paper Study	Interim Report	5/08
DSRC+Positioning only Safety System	Interim Report	11/07
	Interim Report	11/08
VSC System Test Bed	Interim Report	7/08
Objective Test Procedures	Interim Report	11/08
System testing and Objective Test Validation	Interim Report	7/09
Overall VSC-A Project Activities	Final Report	11/09