UNITED STATES
DEPARTMENT OF TRANSPORTATION

Aftermarket Safety Device (ASD) and Forward Collision Avoidance (FCA) Safety Application - Objective Test Procedures

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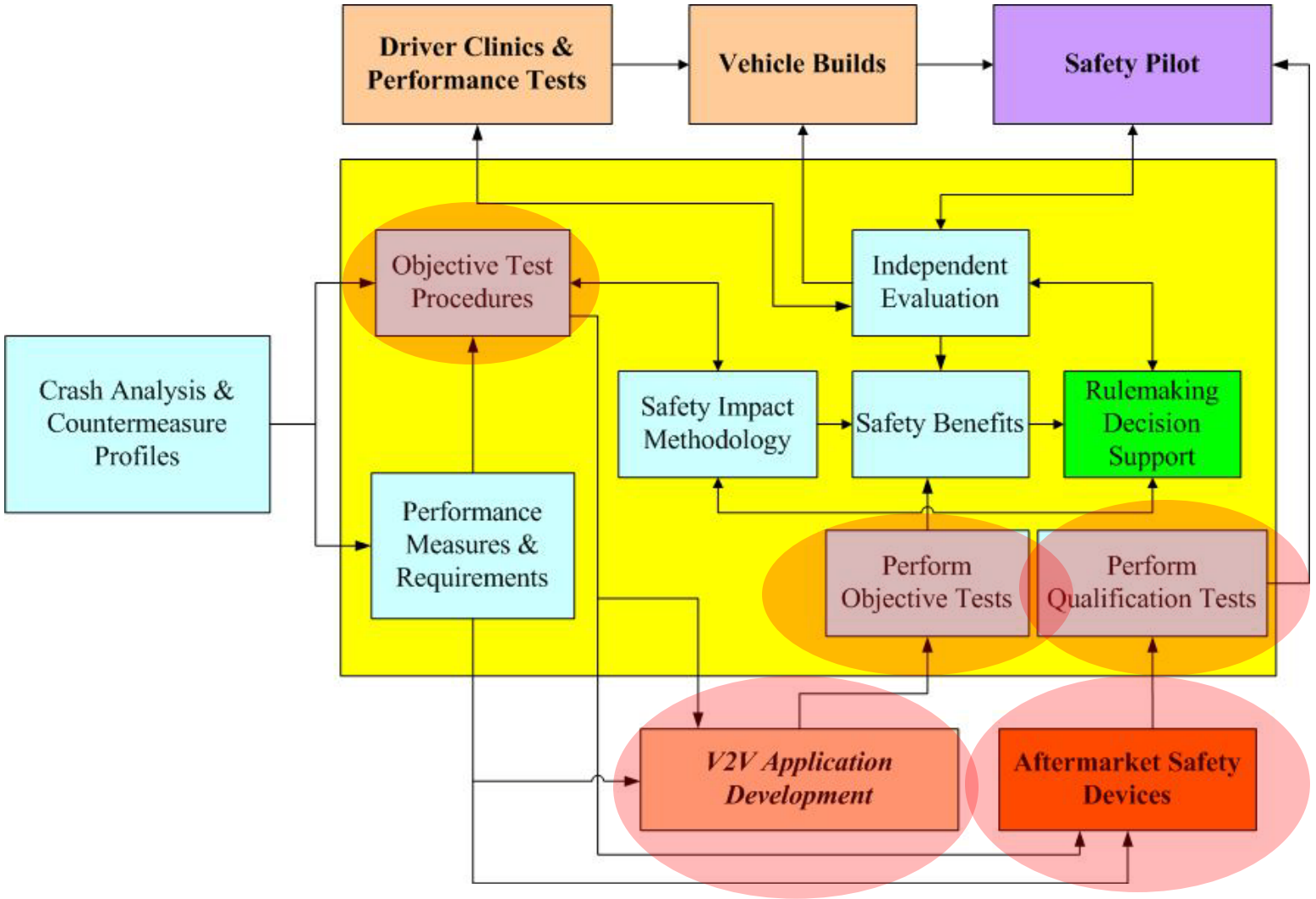
August 2, 2011

Objective Test Procedures – How Do They Fit In ?



Objective Test Procedures - Process

Requirements Capture/Refinement

- Aftermarket Safety Devices (ASD)- new devices from 4 teams with V2V and V2I safety applications
- New Forward Collision Avoidance (FCA) - safety application being developed by several original equipment manufacturers

Develop Test Procedures

- Adapt existing procedures for Aftermarket Safety Devices pass/fail
- New initial conditions from crash data for characterization of Forward Collision Avoidance application

Design and Procure Test Equipment

- What equipment needed to be installed in vehicle under test, Host Vehicle
- What equipment needed for conflict vehicles, Remote Vehicles
- Test track infrastructure equipment

Schedule and Conduct Testing

- Where and when will test procedures and support equipment be developed – test the test
- Where and when will testing be done

Requirements Capture/Refinement

- Aftermarket Safety Devices
  - Establish minimum requirements for use by naive drivers
  - Establish application specific tests and pass/fail criteria for each safety application
- Forward Collision Avoidance
  - Performance characterization testing
  - Modify initial conditions of test procedures to be crash data driven
- Test to be completed one developers' device at a time

Aftermarket Safety Device V2V and V2I applications

	V2V			V2I	
	FCW	EEBL	IMA	CSW	CICAS-V
Cohda - Denso	X	X	X	X	X
Cohda - Visteon	X	X	X	X	
Denso	X	X		X	
Kopsch	?	?		X	

FCW - Forward Collision Warning

EEBL - Emergency Electronic Brake Light

IMA - Intersection Movement Assist

CSW - Curve Speed Warning

CICAS - Cooperative Intersection Collision Avoidance System - Violation

Forward Collision Avoidance Tests

Countermeasure Action Required

1. Stopped remote vehicle at 10th, 50th,90th speed
2. Slower constants speed remote vehicle at 10th, 50th,90th delta speed
3. Modestly slowing RV
4. Aggressively slowing RV
5. Stopped remote vehicle in a curve
6. Slower remote vehicle in a curve
7. Slower remote vehicle after a lane change by host vehicle
8. Cut in by slower remote vehicle
9. Modestly slowing RV1 after RV2 cut out
10. Modestly slowing RV1 after RV2 does not cut out as expected

No Countermeasure Action Allowed

1. Approaching remote vehicles in left and right adjacent lanes
2. In a curve when approaching a remote vehicle in adjacent lane on curve
3. Closely follows remote vehicle
4. Modestly slowing RV1 after RV2 does not cut out as expected

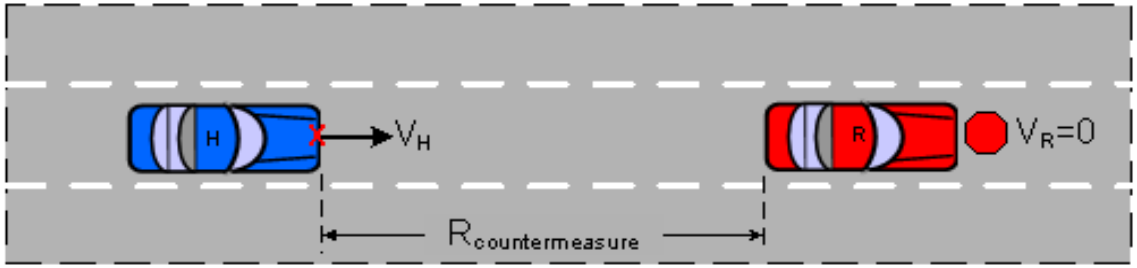
Develop Objective Test Procedures (OTP)

- Develop and publish objective test procedure “Guideline” based on IEEE 829 for aftermarket safety devices and forward collision avoidance developers
- Refine objective test procedures with the latest:
  - Crash data driven initial conditions
  - Performance measures, target/typical values, pass/fail or supplier defined specifications/minimum functional requirements
- Target preliminary procedures mid to late August
- Test the procedures and equipment in 2011 and 2012

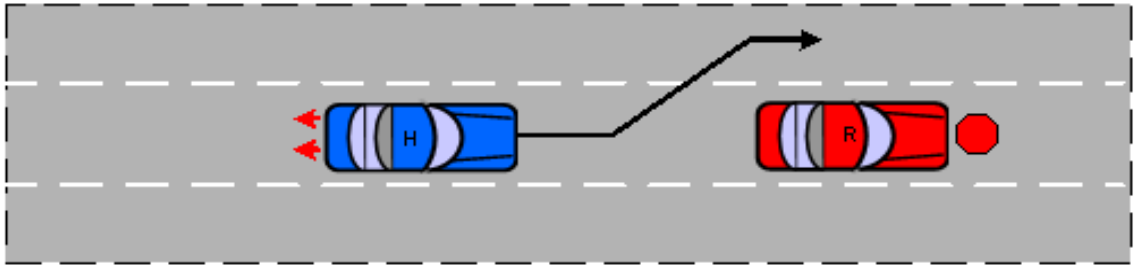
Lead Vehicle Stopped Sample OTP Example

Initial: HV is traveling at constant speed, V_H. RV is stopped ahead in the same lane, at specified range, $R_{Initial}$.

Countermeasure Action: At range, $R_{countermeasure}$, a countermeasure action is expected as the constant speed HV closes on the stopped RV.



Resolution: After a countermeasure action or when the HV driver senses an imminent crash, the HV brakes and changes lanes to avoid a crash.



LVS concept figures

Lead Vehicle Stopped Sample OTP Example

Test Conditions for LVS

Initial Test conditions for Rear-End/LVS @ 10th percentile speed					
$R_{Initial}$	110 m	V_H	11.18 m/sec (25 mph)	V_R	0 mph
Initial Test conditions for Rear-End/LVS @ 50th percentile speed					
$R_{Initial}$	160 m	V_H	15.65 m/sec (35 mph)	V_R	0 mph
Initial Test conditions for Rear-End/LVS @ 90th percentile speed					
$R_{Initial}$	200 m	V_H	20.12 m/sec (45 mph)	V_R	0 mph

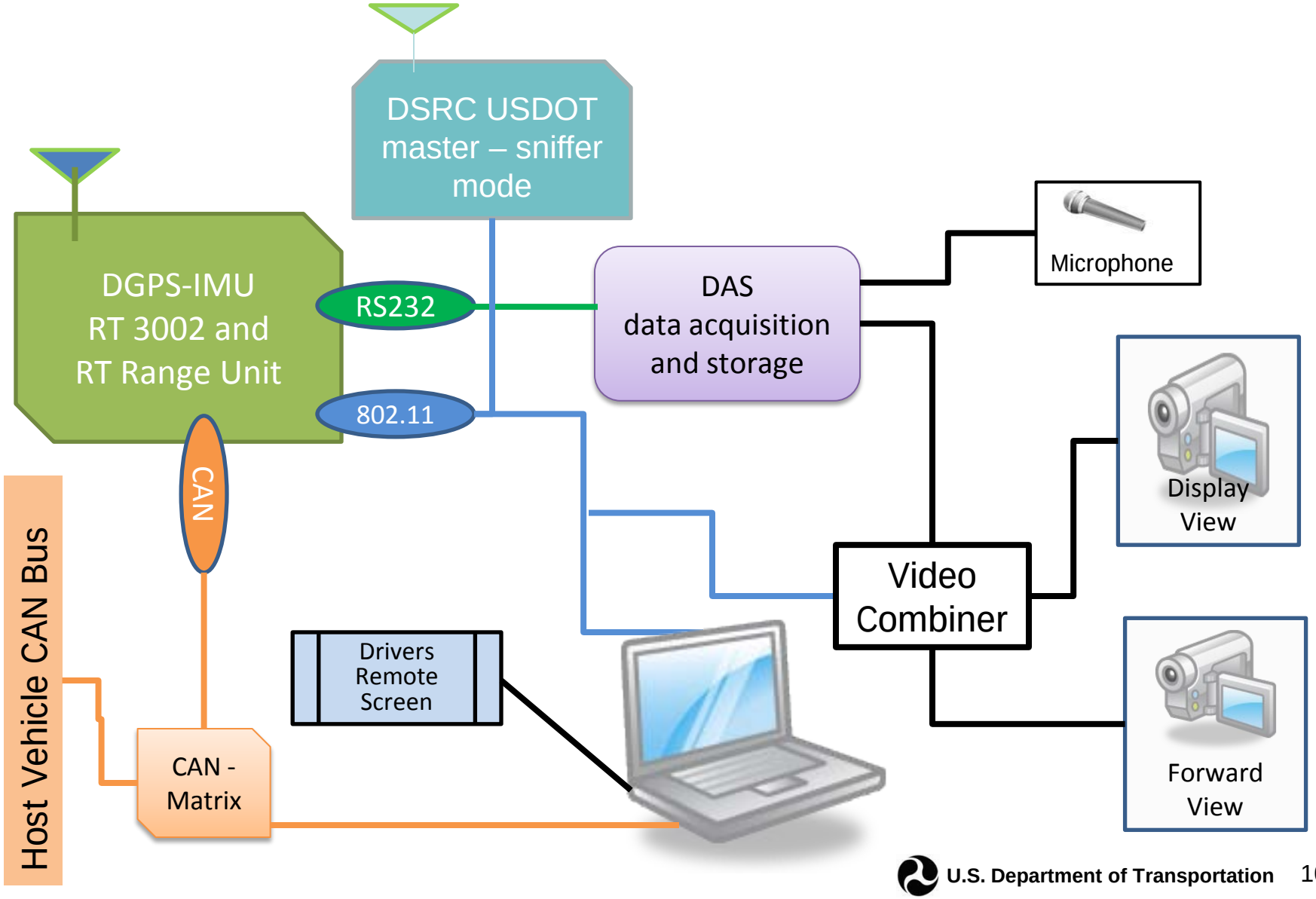
HV Driving Directions

1. HV accelerates to test speed, V_H, and engages cruise control in same lane as the RV, prior to reaching $R_{Initial}$.
2. After a countermeasure action, or when a crash is believed to imminent, resolve the conflict by braking and/or changing lanes to the left.

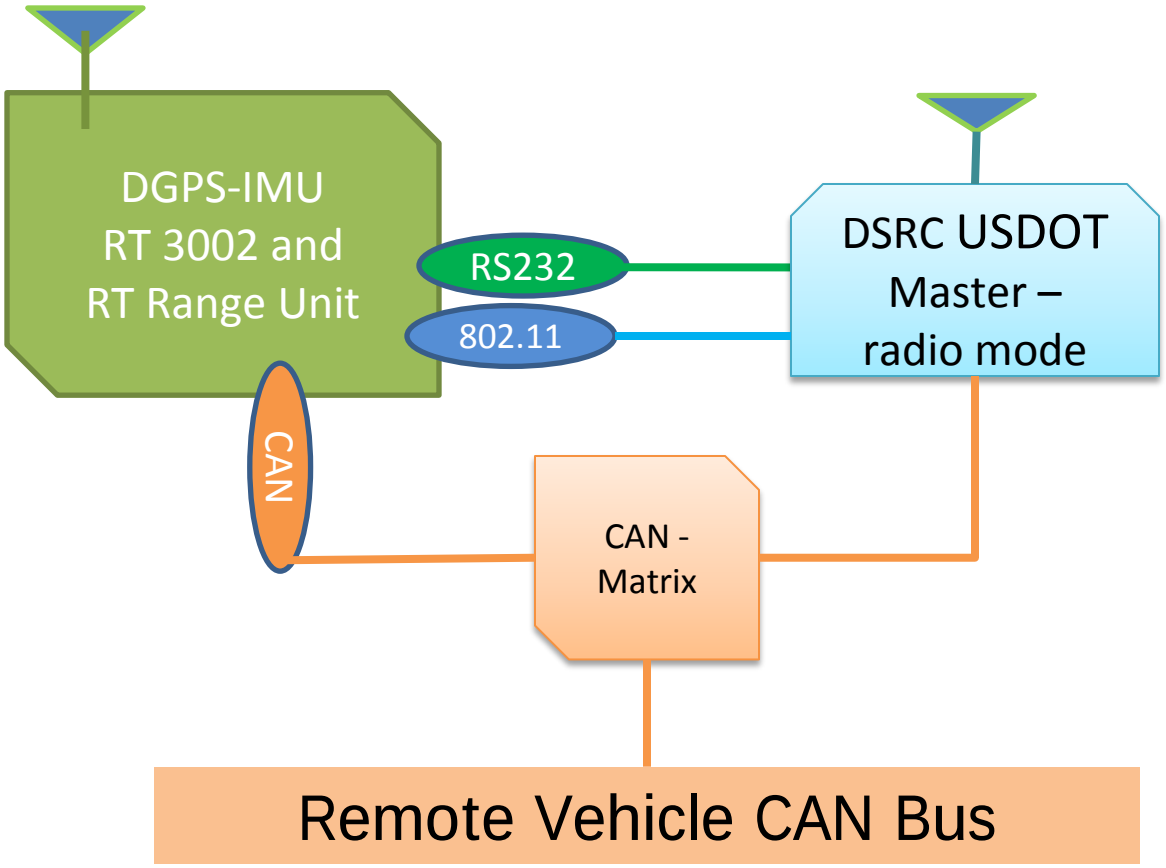
RV Driving Directions

1. The RV remains stopped in the designated lane.
2. The V2V communications system must be active and broadcasting the safety message.
3. The RV driver is not in the RV throughout the test.

Host Vehicle – Independent Measurement System and Test Driver's Aid

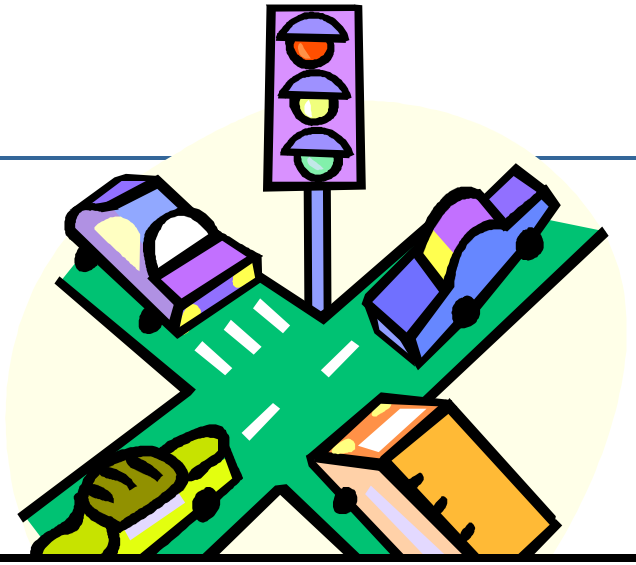


Remote Vehicles 1 & 2 – Lab Grade Positioning, Time Stamp and Safety Message



V2I Roadside Equipment

Master USDOT (RSE) Roadside Equipment-DGPS Safety Message



Cooperative Intersection Collision Avoidance - Violations

Curve Speed Warning

Schedule and Conduct Testing

- Aftermarket Safety Device safety application testing to be concurrent with certification testing. Devices available September 20 - November 30, 2011
  - Testing and results to be concluded between December 31, 2011 and January 15, 2013
- Forward Collision Avoidance application performance testing to begin 12 months from award
  - Includes “Test the Test” and 2 rounds of performance characterization and feedback in 2012 and 2013

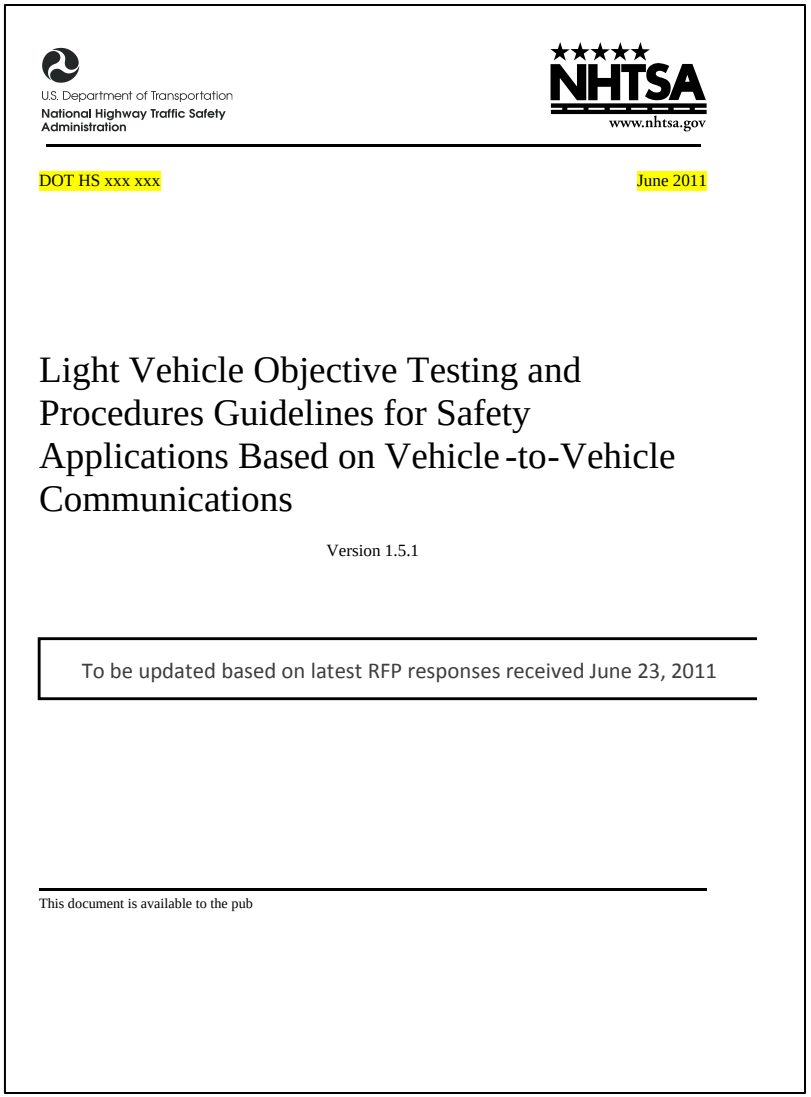
Appendix A – ASD IEEE 829 Guideline Elements

ASD Guideline Elements - IEEE 829 Based	
Test Plan Identifier	Use cover page to identify unique tile and release version including pre-release drafts. Add change history on back of cover page or next page after initial release. Date to be included on all.
Technical Report Documentation Page	U.S. DOT Requirement
Glossary and Acronyms List	Define terms and acronyms used in the document, and testing in general
Terminology	RV-Remote Vehicle, HV-Host Vehicle
Units of measure	Metric with English ref.
Introduction	State the purpose of the Plan, possibly identifying the level of the plan (master etc.).
Test Items (Functions)	OTP procedures will be developed for each application including countermeasure actions and no countermeasure actions warn and no warn criteria
Hardware/Software Risk Issues	Identify what hardware/software is to be tested and what the critical areas are.
Features to be Tested	This is a listing of what is to be tested from the USERS viewpoint of what the system does.
Features not to be Tested	This is a listing of what is NOT to be tested from both the Users viewpoint of what the system does and configuration management/version control view
Approach (Strategy) - Warning, Advisory	This is your overall test strategy for this test plan; it should be appropriate to the level of the plan (master, acceptance, etc.) and should be in agreement with all higher and lower levels of plans.
Warning modality requirements	Refer to ASD requirements for microphone and display

ASD Guideline Elements - IEEE 829 Based	
Objective Evaluation Criteria - Run validity and data needed for benefits assessment	What are the Completion criteria for this plan? This is a critical aspect of any test plan and should be appropriate to the level of the plan.
Suspension Criteria and Resumption Requirements	Know when to pause in a series of tests.
Test Deliverables	Document what is to be delivered as part of this plan.
Remaining Test Tasks	If this is a multi-phase process or if the application is to be released in increments there may be parts of the application that this plan does not address.
Environmental Needs	Are there any special requirements for this test plan.
Instrumentation, equipment and calibration required	Independent measurement system (IMS) for HV and RV(s)
Data Collection	IMS and HV internal
Photographic documentation	
Staffing, Safety Approval and Training Needs	What is to be tested and who is responsible for the testing and training
Test Track and Testing - Roles and Responsibilities	Document roles and responsibilities including track participation
References	List all documents that support this test plan. Refer to the actual version/release number of the document.
Schedule	Should be documented and based on realistic and validated estimates
Planning Risks and Contingencies	What are the overall risks to the project with an emphasis on the testing process
Approvals	Who can approve the process as complete and allow the project to proceed to the next level

Appendix B – IEEE 829 Derived Draft Guidelines

Forward Collision Avoidance -draft



U.S. Department of Transportation
National Highway Traffic Safety Administration

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June 2011

Light Vehicle Objective Testing and Procedures Guidelines for Safety Applications Based on Vehicle-to-Vehicle Communications

Version 1.5.1

To be updated based on latest RFP responses received June 23, 2011

This document is available to the pub

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Thank you!