VOLVO

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Acceptance Test Plan

C030588 CVII Task 2

Task 2 provides the base VII infrastructure in the commercial vehicle on which the remaining tasks will develop commercial applications.

Responsible	Tom Richter
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C030588 CVII Task 2 [21-Jan-2009 to 31-Dec-2010]		Acceptance Test Plan	

Contents

1 General Information

This document describes the acceptance test plan for Task 2 of the NYSDOT CVII Project.

1.1 Document Contacts

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1.2 Revision History

Issue	Date	Author	Changes
1.0	17 Dec 2009	Mike Siebert	Initial

1.3 Reference Documents

[1] Contract #C030588 – PIN: CC95.07.121
Commercial Vehicle Infrastructure Integration
New York State – Department of Transportation
Astrid Glynn, Commissioner

[2] 6980-02821-01-02 C030588 CVII Program Plan
Volvo Technology – Tom Richter
Issue 2.1 – 15 Sep 2009

[3] 6980-02941-01-03 C030588 CVII Task 2 Concept of Operations
Volvo Technology – Mike Siebert
Issue 1.1 – 17 Dec 2009

1.4 Abbreviations

ConOps	Concept of Operations
CVII	Commercial Vehicle to Infrastructure Integration
DOT	Department of Transportation
DMCU	5.9 GHz DSRC Mobile Communications Unit
DSRC	Dedicated Short-Range Communications
GPS	Global Positioning System
IP	Internet Protocol
KTC	Kapsch TrafficCom Inc.
N/A	Not Applicable
NYS	New York State
NYSDOT	New York State Department of Transportation
RSE	Roadside Equipment
SAE	Society of Automotive Engineers
VII	Vehicle to Infrastructure Integration
VTEC	Volvo Technology

1.5 Acceptance Criteria Identification

All acceptance criteria defined in this specification shall utilize the following notation:

Criteria TASK2-nnn/i.i: <Criteria Title>
<Criteria Specification>

Where:

‘nnn’	Serial number: 000-999
‘i.i’	Issue of test plan in which the criteria was added or modified

2 Acceptance Test Procedure

The acceptance test for Task 2 shall be accomplished by running the commercial test vehicle through a test route which will verify that the requirements for the Anonymous Probe Data and In-Vehicle Signage Services have been met. There will be no connectivity to NYS systems available for the acceptance test, so all of these functions shall be simulated.

Anonymous Probe Data Service

The test route has been selected to provide a wide variety of vehicle speeds to exercise the periodic interval trigger for the probe data messages. Test events have been added to create start/stop and vehicle dynamic triggers. These triggers occur both with and without RSE coverage to allow testing the probe data snapshot retention.

The probe data will be collected in a manner which is sufficient to support the analysis of the acceptance criteria.

In-Vehicle Signage Service

The test route specifies the valid regions for a sequence of simulated traveler advisories. The valid regions have been selected to occur both with and without RSE coverage.

2.1 Test Procedure Log

During the execution of the test procedure, a Test Procedure Log shall be maintained as defined in the remainder of this paragraph.

2.1.1 Pre-Test Data

Prior to running the test route, the following information shall be collected:

- Test hardware configuration:
  - System diagram showing:
    - Equipment
    - Connectivity (including IP addresses, etc.)
  - For each equipment item:
    - Manufacturer
    - Model
    - Serial Number

- RSE probe data service configuration
- For each traveler advisory loaded for transmission to the vehicle:
    - Content (category, title, and text lines)
    - Valid region
    - Priority
    - Valid date/times

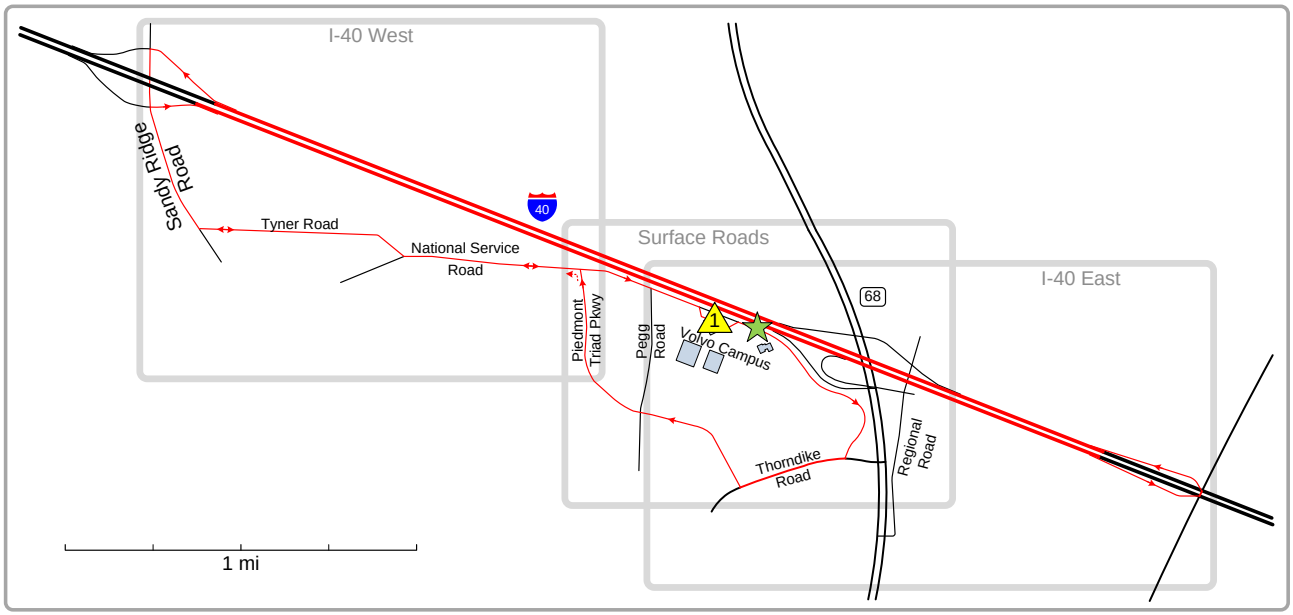
2.1.2 Test Execution Data

During the running of the test route, the following information shall be collected:

- For each executed test event:
    - Time and location when the event was executed
- For each displayed traveler advisory:
    - Content (category, title, and text lines)
    - Display area:
        - Time and location when the display of the advisory started
        - Time and location when the display of the advisory ended
    - Travel direction

2.2 Acceptance Test Route

The acceptance test route for Task 2 shall utilize the public highways around the Volvo campus in Greensboro, NC, as shown highlighted in red on the map below:



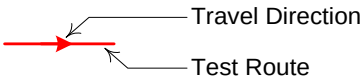
The route begins and ends in the parking lot in front of the Communications Center on the Volvo campus 1. The test RSE is located on the shoulder of I-40 in front of the Volvo campus ★.

Detail Maps

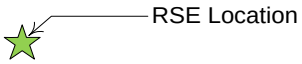
The following paragraphs provide a detail map for each of the three sections shown on the acceptance test route map. The detail maps define the test route, test RSE location, testing events, and the simulated traveler advisories that shall be used for the acceptance of Task 2.

The following notation shall be used on all of the maps:

- Test Route Notation



- RSE Notation

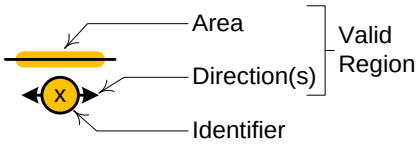


- Test Event Notation

Where:

- Identifier:
  Defines the event via the Test Events table for the associated detail map. The table contains the reference identifier and the action(s) that must be completed.

- Traveler Advisory Notation



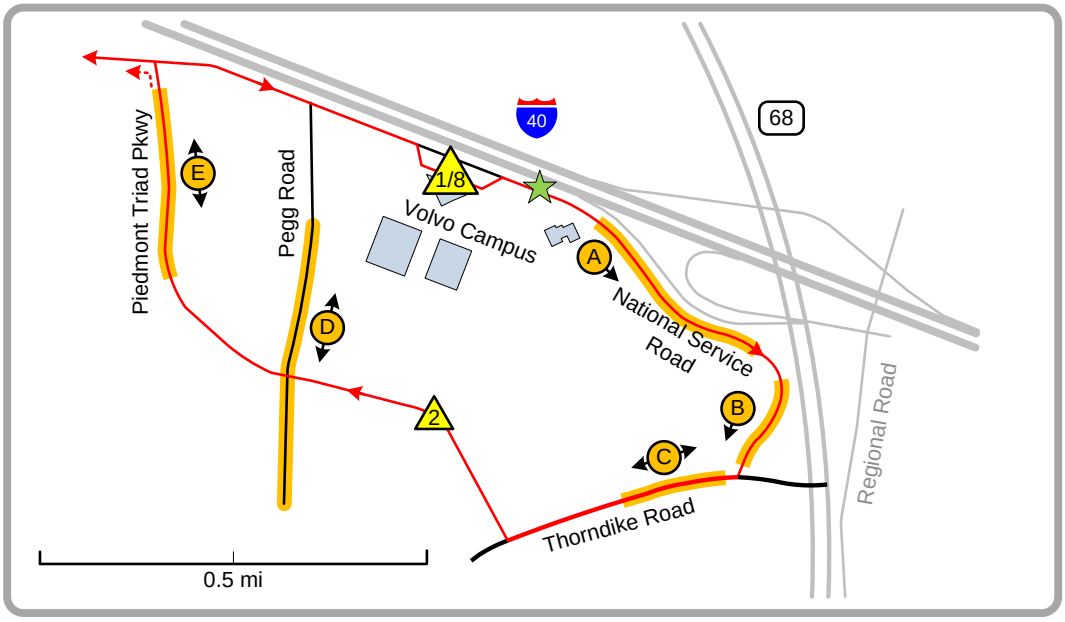
Where:

- Valid Region:
  Defines the Area and Direction(s) where the traveler advisory should be displayed.

- Identifier:
  Defines the traveler advisory content via the Simulated Traveler Advisories table for the associated detail map. The table contains the reference identifier, ITIS category, displayed title/text lines, advisory priority, and valid flag (yes implies that the current time is within the advisory's valid dates/times).

2.2.1 Surface Roads Section

The test RSE only provides coverage for National Service Road from the curve just west of Pegg Road east to the tight curve just east of the Volvo campus on the surface roads in this section.



Test Events

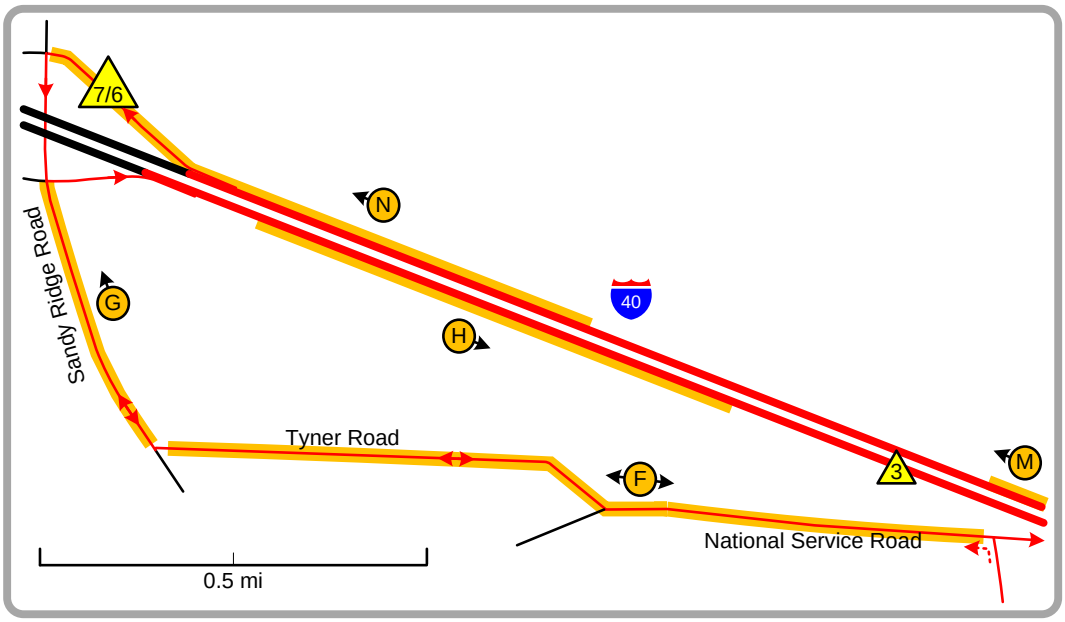
ID	Actions
1	Test Route Begin: The test route shall begin in the parking lot in front of the Communications Center on the Volvo campus. On vehicle start-up, at the beginning of the test, the following simulated vehicle parameters should be set: Vehicle Type: 3 Axle, Single Unit Vehicle Height: 12.0 Feet
2	Vehicle Dynamic Event: A traction control event shall be simulated at the curve in Piedmont Triad Parkway as shown on the map.
8	Test Route End: The test route shall end in the parking lot in front of the Communications Center on the Volvo campus.

Simulated Traveler Advisories

ID	ITIS Category	Title/Text Lines 1-3	Priority	Valid
A	12290 [Warning Sign]	Warning! 1: Dangerous Curve Ahead 2: Rollover Potential 3: Proceed with Caution	High - Warning	Yes
B	12290 [Warning Sign]	Warning! 1: No Trucks Allowed 2: Next Right 3:	High - Warning	Yes
C	12289 [Regulatory Sign]	Notice! 1: No Trucks Allowed 2: On Thorndike Rd 3:	High - Regulatory	Yes
D	12289 [Regulatory Sign]	Notice! 1: Road Closed 2: To Thru Traffic 3:	High - Regulatory	Yes
E	12292 [Construction Sign]	Work Zone! 1: Low Clearance Ahead 2: 12ft 6in 3:	High - TTC	Yes

2.2.2 I-40 West Section

The test RSE does not provide any coverage on the surface roads or interstate in this section.



Test Events

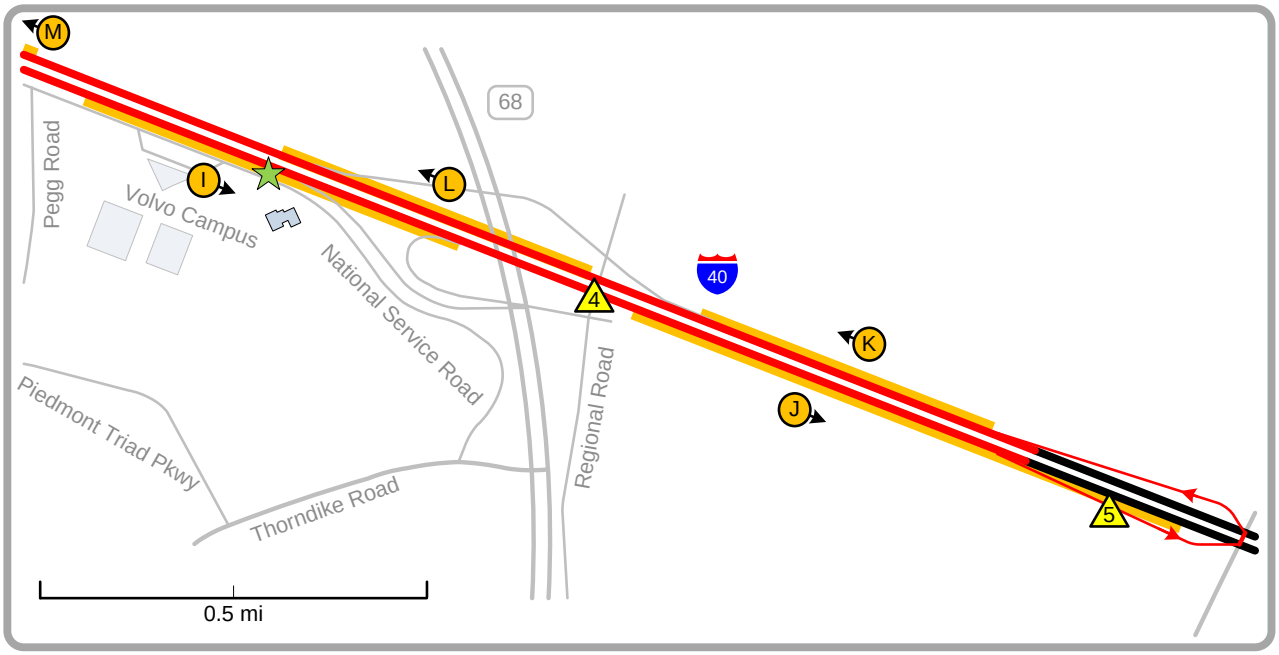
ID	Actions
3	Vehicle Probe Data Change: The vehicle's high beam headlights shall be turned on to create a change in data received from the vehicle data bus.
6	Vehicle Stop: The truck shall park on the shoulder of the off-ramp for a minimum period of 5 minutes, generating a probe data stop trigger.
7	Vehicle Start: At the conclusion of the stop period, the truck shall resume traveling the test route, generating a probe data start trigger. Prior to proceeding on the test route, the following simulated vehicle parameters should be set: Vehicle Type: 5 Axle, Single Trailer Vehicle Height: 13.5 Feet

Simulated Traveler Advisories

ID	ITIS Category	Title/Text Lines 1-3	Priority	Valid
F	12292 [Construction Sign]	Work Zone! 1: Work Zone Ahead 2: Along Tyner Rd 3:	High - TTC	Yes
G	12289 [Regulatory Sign]	Notice! 1: Weight Limit Ahead 2: Max 10 tons on Overpass 3:	High - Regulatory	Yes
H	12291 [Information Sign]	Travel Time 1: To I-73 2: 4 miles 3: 5 minutes	High - TA	Yes
M	12291 [Information Sign]	Travel Time 1: To Sandy Ridge Rd 2: 1 mile 3: 5 minutes	High- TA	No
N	12291 [Information Sign]	CVO Advisory 1: Truck Parking Info 2: Parking Available 3: Next Exit	Low - TA	Yes

2.2.3 I-40 East Section

The test RSE provides full coverage on the interstate in this section.



Test Events

ID	Actions
4	Vehicle Dynamic Event: A Stability Control Event shall be simulated as the truck passes over Regional Road as shown on the map.
5	Vehicle Probe Data Change: The vehicle's high beam headlights shall be turned off to create a change in data received from the vehicle data bus.

Simulated Traveler Advisories

ID	ITIS Category	Title/Text Lines 1-3	Priority	Valid
I	12290 [Warning Sign]	Warning! 1. Merging Traffic 2. Ahead 3.	High - Warning	Yes

ID	ITIS Category	Title/Text Lines 1-3	Priority	Valid
J	12290 [Warning Sign]	Warning! 1. Low Clearance 2. Low Overpass Ahead 3. 12ft 6in	High - Warning	Yes
K	12291 [Information Sign]	CVO Advisory 1. Border Crossing Times 2. Available Mon - Fri 3. 0800 - 1700	High - TA	Yes
L	12290 [Warning Sign]	Warning! 1. Merging Traffic 2. Ahead 3.	High - Warning	Yes
M	(See Section 2.2.2)			

3 Acceptance Criteria

3.1 General

Each of the following criteria shall be evaluated by analyzing the data contained in the log files created by the KTC "COMM_TEST" utility running on both the RSE and the DMCU.

Criteria TASK2-001/1.0: DSRC Range Statistics
The usable DSRC range area for the successful transmission of DSRC data shall a minimum distance of 300 meters between the DMCU and the RSE.

Criteria TASK2-002/1.0: RSE to DMCU Packet Loss Statistics
The RSE to DMCU packet loss within the DSRC range shall be a maximum of 10% in relation to the total DSRC packet transmission.

Criteria TASK2-003/1.0: DMCU to RSE Packet Loss Statistics
The DMCU to RSE packet loss within the DSRC range shall be a maximum of 10% in relation to the total DSRC packet transmission.

Criteria TASK2-004/1.0: Received Signal Strength
The DSRC received signal strength shall be a minimum of 10 dBm at 300 meters.

3.2 Anonymous Probe Data Service

Each of the following criteria shall be evaluated by analyzing the probe vehicle data collected during the test procedure and, where noted, the executed test event data collected in the Test Procedure Log.

Criteria TASK2-005/1.0: Probe Vehicle Service Configuration
The logged RSE probe data service configuration shall be verified for consistency with the test hardware configuration.

Criteria TASK2-006/1.0: Probe Vehicle Data Content
A statistically significant sample of the probe data shall be analyzed to ensure that it is consistent and accurate.

Criteria TASK2-007/1.0: Probe Vehicle Data Change
The probe data shall change appropriately at the executed locations of Test Events 3, 5, and 7 (vehicle probe data changes and vehicle start) as defined in Section 2.

Criteria TASK2-008/1.0: Probe GPS Data Content
All of the GPS data shall be mapped to ensure that positions, times, and road speeds are consistent with the test route and the executed test event data.

Criteria TASK2-009/1.0: Probe Data Periodic Trigger
The periods between each of the probe data messages shall be consistent with the periodic trigger requirements based on the associated probe data road speed values.

Criteria TASK2-010/1.0: Probe Data Stop Trigger
A probe data sample shall exist consistent with the executed time and location of Test Event 6 (vehicle stop) as defined in Section 2.

Criteria TASK2-011/1.0: Probe Data Start Trigger
The first time-ordered probe data sample following the probe data stop trigger sample shall be consistent with the executed time and location of Test Event 7 (vehicle start) as defined in Section 2.

Criteria TASK2-012/1.0: Probe Data Dynamic Vehicle Event Trigger
Probe data samples shall exist consistent with the executed time and location of Test Events 2 and 4 (vehicle dynamic events) as defined in Section 2.

3.3 Traveler Advisory Service

Each of the following criteria shall be evaluated by analyzing the traveler advisory data collected in the Test Procedure Log.

Criteria TASK2-013/1.0: Traveler Advisory Definitions
The traveler advisories for transmission to the vehicle shall be verified for consistency with the definitions specified in Section 2.

Criteria TASK2-014/1.0: Traveler Advisory Display Consistency
All of the displayed advisory's content, display area, and travel direction shall be consistent with the test route definitions in Section 2.

Criteria TASK2-015/1.0: Traveler Advisory Display Completeness
All advisories defined in Section 2 shall be displayed with the exception of advisories D and M.

Criteria TASK2-016/1.0: Invalid Travel Advisory Direction
Advisory D, defined in Section 2 to cross the test route, shall not be displayed because the travel direction is invalid.

Criteria TASK2-017/1.0: Multiple Travel Advisory Direction Display
Advisory F, defined in Section 2 to be valid in both travel directions, shall be displayed during both the outbound and return of the test route.

Criteria TASK2-018/1.0: Single Travel Advisory Direction Display
Advisory G, defined in Section 2 to be valid in the northerly direction, shall be shown only on the outbound portion of the test route.

Criteria TASK2-019/1.0: Invalid Travel Advisory Date/Time
Advisory M, defined in Section 2 to be valid at a date/time after the test route is run, shall not be shown.

Criteria TASK2-020/1.0: Traveler Advisory Driver Distraction
Advisory N, defined in Section 2 to be low priority advisory, shall not be shown until the vehicle slows to a stop at Test Event 6 in accordance with driver distraction requirements.

Table of Tests