

# VOLVO

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Customer Contract Number C030588	Customer Contract Start/Finish Dates 21-Jan-2009 to 31-Dec-2010		

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## Concept of Operations

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### C030588 CVII Task 2

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

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<b>Responsible</b>	Tom Richter
<b>Established Date</b>	23-Oct-2009
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## 1 General Information

This document describes the concept of operations and requirements 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	29 Sep 2009	Mike Siebert	Initial
1.1	17 Dec 2009	Mike Siebert	- 3.1: Removed vehicle data items 'Brake Applied Pressure' and 'Throttle Position' as they are not available in the DSRC message set. - 4.1: Modified geo-fence based warning requirement in accordance with NYS comments.

### 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

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- [3] NYS CVII DSRC Message Set  
Southwest Research Institute – Mike Brown  
Issue 1.0 – 09 Oct 2009  
[Based on SAE J2735 DSRC Message Set Dictionary]
- [4] DMCU/Vehicle Gateway Interface Definition  
Southwest Research Institute – Mike Brown  
Issue 1.0.0 – 09 Oct 2009
- [5] 6980-02821-01-04 State-of-the-Art Review on Information and Warning Strategies  
Volvo Technology – Paul Piamonte  
Issue 1.0 – 09 Oct 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
ECU	Electronic Control Unit
GIS	Geographic Information System
GPS	Global Positioning System
GSCS	Government Safety and Credentials System
HVI	Human Vehicle Interface
IP	Internet Protocol
MMS	Message Management System
N/A	Not Applicable
NYS	New York State
NYSDOT	New York State Department of Transportation
RSE	Roadside Equipment
SAE	Society of Automotive Engineers
TGW	Volvo Telematics GateWay
VII	Vehicle to Infrastructure Integration
VTEC	Volvo Technology
WAVE	Wireless Access in a Vehicular Environment

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## 1.5 Requirement Identifier

### *Req TASK2-001/1.0: Requirement Identifier*

The requirement identifier for this specification shall be TASK2.

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## 2 Task 2 Concept

### 2.1 Background

The overall scope of the NYSDOT CVII Project can be found in References [1] and [2].

Task 2 builds on hardware and software, previously developed for the Vehicle Infrastructure Integration initiative, supporting anonymous probe data and in-vehicle signage.

### 2.2 Objectives

The objectives of Task 2 are to create a base VII hardware infrastructure suitable for a commercial vehicle, install a VII RSE for system testing/demonstration, and develop two simple VII services, one outbound and one inbound, to prove the hardware functionality.

The specific activities required for Task 2 are:

- Install the commercial test vehicle hardware
  - Select and purchase the hardware
  - Design the electrical interfaces, wiring harnesses, and mounting techniques
  - Complete the hardware installation
  - Successful completion of the 2 service development activities below
- Install the Greensboro Test RSE
  - Select and purchase the hardware
  - Design the electrical interfaces, wiring harnesses, and mounting techniques
  - Select the installation site
  - Complete the hardware installation
- Develop an extended anonymous probe data service
  - Supports standard VII defined probe data including commercial vehicle related data elements
  - Complete acceptance test of the application
- Develop a commercial vehicle signage service
  - Includes standard VII defined signage

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- Adds commercial vehicle signage
- Provides an HVI consistent with the commercial vehicle environment
- Complete acceptance test of the application

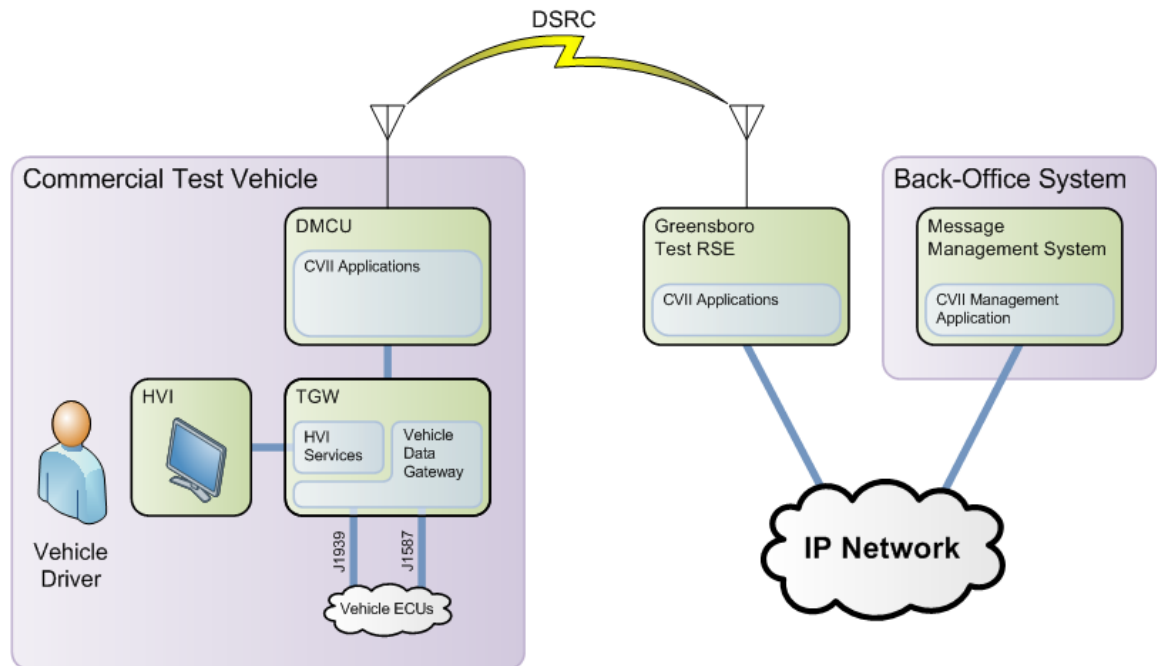
Successful completion of the acceptance test for the 2 application development activities will serve as the acceptance criteria for the 2 installation activities.

## 2.3 System Overview

The following components are utilized in Task 2:

- Commercial Test Vehicle includes:
  - DMCU
  - TGW
  - HVI
- The off-board system includes:
  - Greensboro Test RSE
  - MMS

The figure below shows the relationships between the components.



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## 2.4 Operational Scenarios

Task 2 has two independent service development activities which must be completed prior to acceptance testing. The detailed use cases for these two services are provided below.

### 2.4.1 Anonymous Probe Data Service Use Cases

#### Probe Data Service Registration Use Case

Triggers:

- An administrator needs to add or reconfigure the anonymous probe data service on an installed RSE.

Use case:

- The administrator logs into the affected RSE.
- The administrator configures the required routing to the MMS supporting the anonymous probe data service.
- The administrator logs out of the RSE.

#### Vehicle Dynamic Event Use Case

Trigger:

- Occurrence of one of the monitored vehicle events.

Use case:

- The TGW sends a vehicle dynamic event to the DMCU.

#### Probe Data Snapshot Collection Use Case

Triggers:

- Periodic schedule event
- Start or stop event
- Vehicle dynamic event

Use case:

- The DMCU collects a probe data snapshot
  - Vehicle data requested from the TGW
- The DMCU caches the probe data snapshot.



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## Probe Data Snapshot Transmission Use Case

Trigger:

- Connection to an RSE supporting the anonymous probe data service with one or more cached probe data snapshots.

Use case:

- The DMCU packages the cached probe data snapshot(s) into a standard probe message which is sent to the RSE.
- The RSE routes the probe message to the configured MMS.
- The MMS will aggregate and store the received probe data.

## Probe Data Viewing Use Case

Trigger:

- A user requests to view the probe data via the MMS user interface.

Use case:

- The MMS displays the probe data.

## 2.4.2 Commercial Vehicle Signage Service Use Cases

### Sign Change Use Case

Trigger:

- A user requests to change a sign via the MMS user interface.

Use case:

- The MMS will support a simple, conceptual form which will allow a sign, either static or dynamic, to be created, modified, or deleted.
- The MMS determines which RSE's should handle the sign.

### Sign Broadcast Use Case

Trigger:

- Periodic schedule event

Use case:

- The MMS sends applicable sign messages based on validity, region, and heading to each configured RSE.

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- The RSE broadcasts the sign messages.
- Any DMCU in range of one of these RSE's receives and stores the sign messages.

### **Sign Activation Use Case**

Trigger:

- The validity, region, and heading parameters for a stored sign message are satisfied by the current date/time and vehicle position.

Use case:

- The DMCU sends the newly activated sign message to the TGW.
- The TGW caches the sign message.
- The TGW displays the sign to the driver within the constraints of:
  - Driver distraction management

### **Sign Deactivation Use Case**

Trigger:

- The validity, region, and heading parameters for a stored sign message are no longer satisfied by the current date/time and vehicle position.

Use case:

- The DMCU sends a deactivation message to the TGW.
- If the sign is being actively displayed, the TGW stops displaying it.
- The TGW removes the sign message from the cache.

### **Sign Outdated Use Case**

Trigger:

- A stored sign message is determined to be outdated.

Use case:

- The DMCU removes the sign message from storage.

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## 3 Anonymous Probe Data Service Requirements

### 3.1 Supported Vehicle Data

#### *Req TASK2-002/1.1: Supported Vehicle Data*

The system shall support the following subset of the vehicle data items defined in Reference [3]:

- Characteristics:
  - Vehicle type
  - Vehicle height
- Weight
  - Vehicle mass
- Brakes:
  - Anti lock brake status
- Miscellaneous:
  - Exterior Lights
  - Ambient Air Temperature

### 3.2 RSE Probe Data Service

#### *Req TASK2-003/1.0: Probe Data Service Configuration*

The RSE shall support an administrative interface which allows for the configuration of the probe data service, including routing information to the MMS probe data application supporting the service.

#### *Req TASK2-004/1.0: Probe Data Service Notification*

When configured appropriately, the RSE shall support probe data service notification to connected DMCU's.

#### *Req TASK2-005/1.0: Probe Data Message Routing*

When configured appropriately, the RSE shall route a received probe data message to the MMS via the IP Network.

### 3.3 DMCU Probe Data Application

#### *Req TASK2-006/1.0: Probe Data Snapshot Triggers*

The DMCU shall collect a probe data snapshot on the following triggers which are defined in Reference [3]:

- Periodic interval while the vehicle is moving
- Every time the vehicle starts or stops moving
- On each occurrence of a vehicle dynamic event

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### ***Req TASK2-007/1.0: Probe Data Snapshot Data Sources***

The DMCU shall collect the probe data from the following sources:

- GPS data (Location and time):  
Broadcast by the TGW
- Vehicle data:  
Requested from the TGW using the protocol defined in Reference [4]
- Received Signal Strength:  
Requested from the Wave Radio

### ***Req TASK2-008/1.0: Probe Data Snapshot Retention***

The DMCU shall queue a minimum number of probe data snapshots, defined in Reference [3], until an RSE supporting the anonymous probe data service is contacted.

### ***Req TASK2-009/1.0: Probe Data Queue Overflow***

If the DMCU's probe data snapshot queue overflows, the DMCU shall follow the requirements specified in Reference [3].

### ***Req TASK2-010/1.0: Probe Data Message Transmission***

When an RSE configured for the probe data service is contacted and there is at least one probe data snapshot in the queue, the DMCU shall encode all of the enqueued probe data snapshots into a single probe vehicle data message, defined in Reference [3], and anonymously transmit it to the RSE.

## **3.4 TGW Probe Data Application**

### ***Req TASK2-011/1.0: Vehicle Characteristics***

The TGW shall support a simple HVI, which meets the requirements of Reference [5], capable of collecting the vehicle type and height from the driver.

### ***Req TASK2-012/1.0: GPS Time/Position Data Broadcast***

The TGW shall broadcast a current GPS location and time message, defined in Reference [4], to the DMCU once a second.

### ***Req TASK2-013/1.0: Vehicle Data Collection***

On request from the DMCU, the TGW shall collect and send the vehicle data defined in the supported vehicle data requirement in Paragraph 3.1 above to the DMCU using the protocol defined in Reference [4].

### ***Req TASK2-014/1.0: Vehicle Dynamic Event***

The TGW shall support the simulation of a vehicle dynamic event on demand, which shall result in the TGW sending a vehicle dynamic event message, defined in Reference [4], to the DMCU.

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## 3.5 MMS Probe Data Application

### ***Req TASK2-015/1.0: Probe Vehicle Data Message Reception***

The MMS shall be capable of receiving a probe vehicle data message, defined in Reference [3], from the IP Network.

### ***Req TASK2-016/1.0: Probe Data Application Functionality***

The MMS shall support an application which stores and aggregates the received probe data.

### ***Req TASK2-017/1.0: Probe Data Display***

The MMS shall support a simple display of the probe data on a GIS map and in tabular form sufficient to allow verification of the service.

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## 4 In-Vehicle Signage Service Requirements

### 4.1 Supported Traveler Advisories

#### *Req TASK2-018/1.1: Supported Traveler Advisories*

The system shall as a minimum support the following traveler advisory types:

- Static roadside signs
  - Height restrictions
  - Weight restrictions
  - Curve speed limit warnings
- Dynamic travel information
  - Truck travel times
  - Truck parking availability
  - Border crossing wait times
- Localized time sensitive travel information
  - Work zones
  - Temporary restrictions (over-size/over-weight)
  - Geo-fence based warnings (e.g. restrictive routing, driving wrong direction, etc.)

### 4.2 MMS Traveler Advisory Application

#### *Req TASK2-019/1.0: Traveler Advisory*

All traveler advisories provided by the MMS shall be simulated (i.e. designed purely for the acceptance testing and demonstration of this project).

#### *Req TASK2-020/1.0: Traveler Advisory Generation*

The MMS shall support a simple user interface, sufficient to allow verification of the service, which allows the traveler advisories specified in the supported traveler advisories requirement defined in Paragraph 3.1 above to be created, modified, or deleted.

#### *Req TASK2-021/1.0: RSE Determination*

When a traveler advisory is created or modified, the MMS shall determine which RSE(s) should be used to broadcast the advisory.

#### *Req TASK2-022/1.0: Traveler Advisory Routing*

At 10 second intervals, the MMS shall route each active traveler advisory to the assigned RSE(s) via the IP Network.

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### 4.3 RSE Traveler Advisory Service

#### ***Req TASK2-023/1.0: Traveler Advisory Broadcast Service***

The RSE shall be capable of broadcasting a traveler advisory message received via the IP Network.

### 4.4 DMCU Traveler Advisory Application

#### ***Req TASK2-024/1.0: Traveler Advisory Message Reception***

The DMCU shall be capable of receiving and caching traveler advisory messages, defined in Reference [3], that are broadcast by an RSE.

#### ***Req TASK2-025/1.0: Traveler Advisory Updates***

The DMCU shall use the advisory ID in newly received traveler advisory messages to identify updates to previously cached traveler advisories as defined in Reference [3] and, if the advisory is active, shall update the TGW.

#### ***Req TASK2-026/1.0: Traveler Advisory State***

The DMCU shall monitor the current GPS location, heading, and date/time against the valid area(s), headings, and dates/times for each cached traveler advisory to determine when each advisory's state is active or inactive.

#### ***Req TASK2-027/1.0: Traveler Advisory Activation***

When a traveler advisory's state transitions to active, the DMCU shall send the traveler advisory to the TGW using the protocol defined in Reference [4].

#### ***Req TASK2-028/1.0: Traveler Advisory Deactivation***

When a traveler advisory's state transitions to inactive, the DMCU shall send a traveler advisory deletion to the TGW using the protocol defined in Reference [4].

#### ***Req TASK2-029/1.0: Outdated Traveler Advisory Detection***

When the DMCU determines that a traveler advisory is outdated as defined in Reference [3], the DMCU shall delete the outdated advisory.

#### ***Req TASK2-030/1.0: Traveler Advisory Retention***

The DMCU shall discard all cached traveler advisories when powered down.

### 4.5 TGW Traveler Advisory Application

#### ***Req TASK2-031/1.0: Traveler Advisory Caching***

When a traveler advisory is received from the DMCU via the protocol defined in Reference [4], the TGW shall cache the advisory until it is deleted or until the end of the driving cycle.

#### ***Req TASK2-032/1.0: Traveler Advisory Types***

As a minimum, the TGW shall be capable of displaying the types of traveler advisories specified in the supported traveler advisories requirement defined in Paragraph 3.1 above.

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***Req TASK2-033/1.0: Driver Distraction Management***

To the greatest degree possible, the TGW shall support the driver distraction management principles defined in Reference [5] based on the priority of the traveler advisory.

***Req TASK2-034/1.0: Traveler Advisory Display***

All high and medium priority traveler advisories shall be automatically displayed to the driver as they are received.

***Req TASK2-035/1.0: Traveler Advisory Clearing***

The driver shall be capable of clearing a traveler advisory from the display.

***Req TASK2-036/1.0: Traveler Advisory Deletion***

When a traveler advisory deletion is received from the DMCU via the protocol defined in Reference [4], the TGW shall remove the traveler advisory from the cache and, if applicable, from active display.





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