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Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 1 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Customer Contract Number C030588	Customer Contract Start/Finish Dates 21-Jan-2009 to 31-Dec-2010		

Concept of Operations

C030588 CVII Task 4

Task 4 builds on the base CVII infrastructure developed in Task 2 and the driver credential verification developed in Task 3 providing a wireless roadside vehicle safety inspection application based on the real-time collection of vehicle data.

Responsible	Tom Richter
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VOLVO

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 2 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
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Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Contents

1	General Information	3
1.1	Document Contacts	3
1.2	Revision History	3
1.3	Reference Documents	3
1.4	Abbreviations	4
1.5	Requirement Identifier	5
2	Task 4 Concept	6
2.1	Background	6
2.2	Objectives	6
2.3	System Overview	6
2.4	Operational Scenarios	7
2.4.1	Broadcast Inspection Request Use Case	9
2.4.2	Send Inspection Message Use Case	9
2.4.3	Request Inspection Advisory Use Case	10
2.4.4	Display Inspection Advisory Use Case	11
3	Task 4 Requirements	13
3.1	General	13
3.2	RSE WRI Service	14
3.2.1	GBS Simulation	15
3.3	DMCU WRI Application	16
3.4	TGW WRI Application	17

VOLVO

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 3 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
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Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

1 General Information

This document describes the concept of operations and requirements for Task 4 of the NYSDOT CVII Project.

1.1 Document Contacts

Company	Name	Phone	Email
VTEC	Mike Siebert	+1 (336) 393-3171	mike.siebert@volvo.com
VTEC	Tom Richter	+1 (336) 393-2371	tom.richter@volvo.com

1.2 Revision History

Issue	Date	Author	Changes
1.0	21 May 2010	Mike Siebert	Initial
1.1	11 Jun 2010	Mike Siebert	Incorporated review comments from NYS.

1.3 Reference Documents

- [1] Contract #C030588 – PIN: CC95.07.121
Commercial Vehicle Infrastructure Integration
New York State – Department of Transportation
- [2] 6980-02821-01-02 C030588 CVII Program Plan
Volvo Technology – Tom Richter
Issue 2.1 – 15 Sep 2009
- [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]

VOLVO

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 4 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

- [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
- [6] 6980-02941-01-05 C030588 CVII Task 3 Concept of Operations
Volvo Technology – Tom Richter
Issue 1.0 – 19 Apr 2010

1.4 Abbreviations

ABS	Anti-lock Brake System
CDL	Commercial Drivers License
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
GBS	Government Back-office System
GPS	Global Positioning System
HVI	Human Vehicle Interface
IP	Internet Protocol
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
VIN	Vehicle Identification Number
VTEC	Volvo Technology
WRI	Wireless Roadside Inspection

VOLVO

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 5 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

1.5 Requirement Identifier

Req TASK4-001/1.0: Requirement Identifier

The requirement identifier for this specification shall be TASK4.

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 6 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

2 Task 4 Concept

2.1 Background

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

Task 4 builds on the base CVII infrastructure, developed in Task 2, and the driver credential validation application, developed in Task 3, to create a Wireless Roadside Inspection (WRI) Application.

2.2 Objectives

The objectives of Task 4 are to develop and demonstrate a CVII application which performs a wireless roadside safety inspection of a commercial vehicle.

The specific activities required for Task 4 are:

- Develop a wireless roadside inspection application
 - Define an extension to the SAE J2735 DSRC Message Set Dictionary, which is used in existing IntelliDriveSM applications, which is compatible with existing message set definitions
 - Collect the commercial vehicle's inspection data
 - Provide an inspection application which interfaces to a government back-office system
 - Provide an HVI consistent with the commercial vehicle environment
 - Complete acceptance test of the application

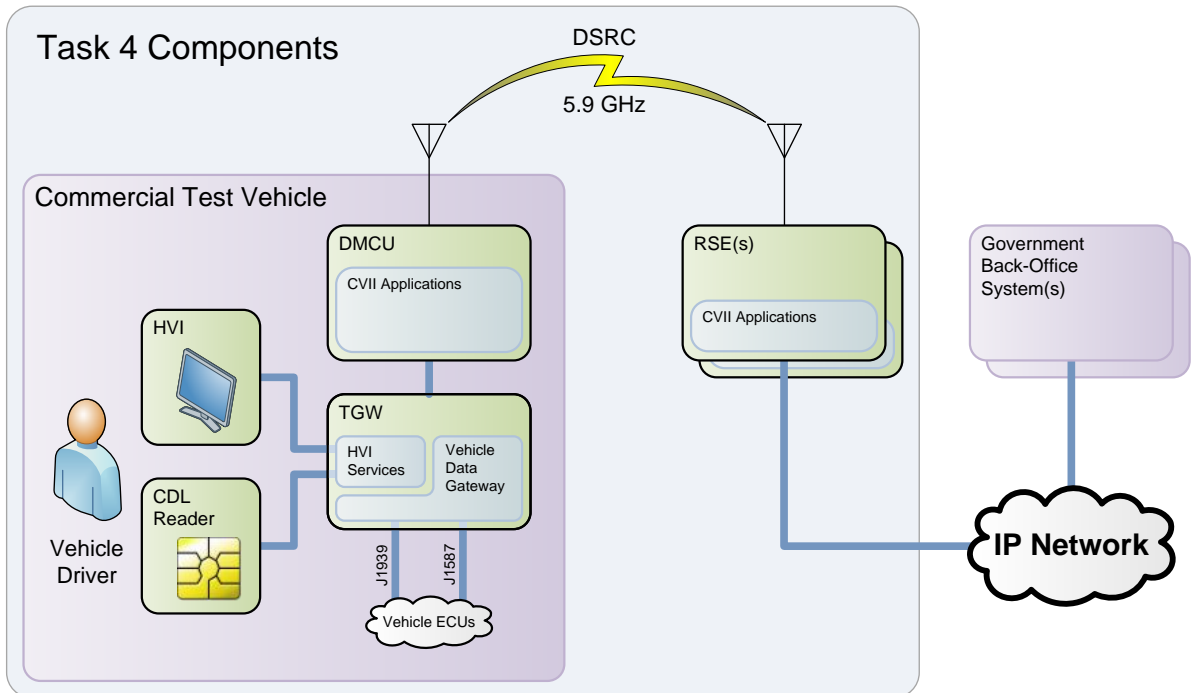
2.3 System Overview

The following components are utilized in Task 4:

- Commercial Test Vehicle includes:
 - DMCU
 - TGW
 - HVI
 - CDL Reader
- The off-board system includes:
 - RSE(s)
[Supporting an IP Network connection to one or more NYS GBS]

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 7 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980	Author Phone +1 (336) 393-3171	
Customer Company New York State DOT	Customer Name Rick McDonough	Customer Phone +1 (518) 457-5871	
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]	Type of Document Concept of Operations		

The figure below shows the relationships between the Task 4 components as well as the externally connected NYS GBS.



2.4 Operational Scenarios

The modular structure of the service use cases can support a wide variety of operational scenarios based on the provided inspection data. This can include true inspection scenarios such as:

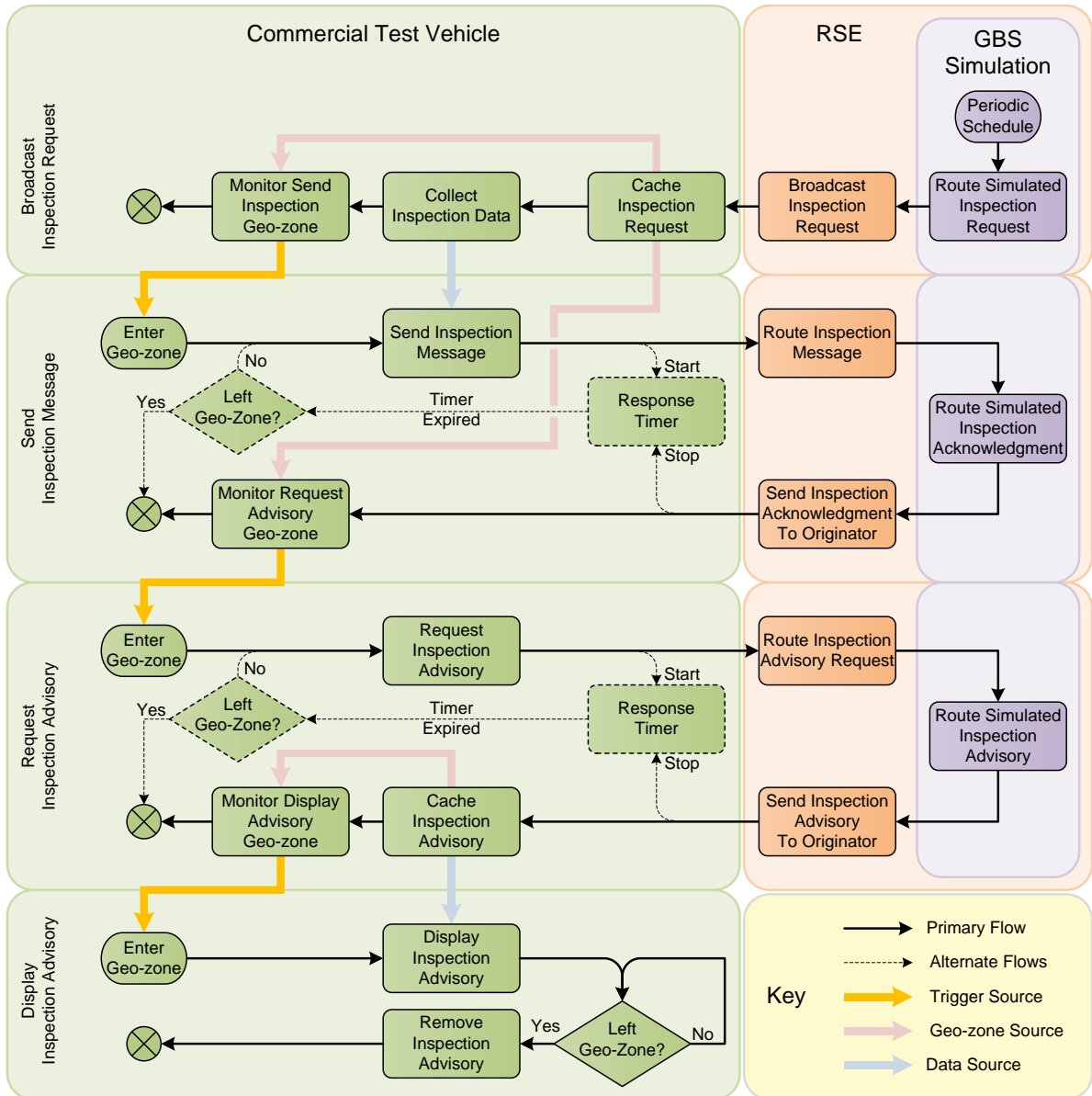
- Safety inspection station bypass
- Temporary safety inspection stations
- Mobile safety inspections
- Virtual safety inspections

But the service can also be used to provide fleets with valuable data for normal fleet operations which is not processed by an enforcement division. These scenarios include:

- Self-inspections by the fleet safety officer
- Vehicle maintenance
- Fleet management

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 8 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
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Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

The detailed use cases for the service are defined in the following paragraphs. The figure below shows an overview of the use cases.



Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 9 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980	Author Phone +1 (336) 393-3171	
Customer Company New York State DOT	Customer Name Rick McDonough	Customer Phone +1 (518) 457-5871	
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

2.4.1 Broadcast Inspection Request Use Case

This use case allows the GBS to broadcast a request for inspection data to all appropriately equipped vehicles within range of one or more selected RSE's.

Triggers:

- GBS Simulation periodic schedule event.

Use Case:

- The RSE:
 - The GBS Simulation routes a simulated inspection request which has been preselected to the RSE application containing:
 - Send inspection geo-zone
 - Request advisory geo-zone
 - Broadcasts the inspection request.
- The DMCU (in range of the broadcasting RSE):
 - Caches the received inspection request.
 - Requests inspection data from the TGW.
- The TGW:
 - Collects the inspection data.
 - Sends the inspection data to the DMCU.
- The DMCU:
 - Receives the inspection data
 - Formats the inspection data into an inspection message
 - Monitors the send inspection geo-zone specified in the inspection request and, when/if it is satisfied, creates a trigger event for the Send Inspection Message Use Case.
- The use case ends.

2.4.2 Send Inspection Message Use Case

This use case supports the vehicle's transmission of inspection data to the GBS which requested the inspection.

Triggers:

- A send inspection message trigger event.

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 10 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Use Case:

- The DMCU sends the inspection message to a connected RSE and starts a response timer.
[Alternative: Inspection Message - Response Timer Expired]
- The RSE:
 - Routes the inspection message to the GBS via the IP Network.
 - The GBS Simulation routes a simulated receipt acknowledgement to the RSE service via the IP Network.
 - Sends the receipt acknowledgement to the originating DMCU.
- The DMCU:
 - Stops the response timer.
 - Monitors the request advisory geo-zone specified in the inspection request and, when/if it is satisfied, creates a trigger event for the Request Inspection Advisory Use Case.
- The use case ends.

Alternative: Inspection Message - Response Timer Expired:

The DMCU does not receive a receipt acknowledgement from the RSE within a reasonable time period.

- The DMCU restarts the Send Inspection Message Use Case.
[Alternative: Inspection Message - Vehicle Leaves Geo-Zone]

Alternative: Inspection Message - Vehicle Leaves Geo-Zone:

The vehicle leaves the send inspection message geo-zone.

- The use case ends.

2.4.3 Request Inspection Advisory Use Case

This use case, optional at the discretion of the GBS, supports the retrieval of an inspection advisory from the GBS which is based on the results of the inspection.

Triggers:

- A request inspection advisory trigger event.

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 11 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Use Case:

- The DMCU:
 - Requests the inspection advisory from a connected RSE and starts a response timer.
[Alternative: Inspection Advisory - Response Timer Expired]
- The RSE:
 - Routes the inspection advisory request to the GBS via the IP Network.
 - The GBS Simulation routes a simulated inspection advisory to the RSE service via the IP Network.
 - Sends the inspection advisory message to the originating DMCU.
- The DMCU:
 - Stops the response timer.
 - Caches the inspection advisory message.
 - Monitors the display inspection advisory geo-zone specified in the inspection advisory message and, when/if it is satisfied, creates a trigger event for the Display Inspection Advisory Use Case.
- The use case ends.

Alternative: Inspection Advisory - Response Timer Expired:

The GBS has not finished processing the inspection message to create the inspection advisory or the connection between the DMCU and RSE has been lost.

- The DMCU restarts the Request Inspection Advisory Use Case.
[Alternative: Inspection Advisory - Vehicle Leaves Geo-Zone]

Alternative: Inspection Advisory - Vehicle Leaves Geo-Zone:

The vehicle leaves the request inspection advisory geo-zone.

- The use case ends.

2.4.4 Display Inspection Advisory Use Case

This use case, optional at the discretion of the GBS, supports the display of a retrieved inspection advisory to the driver.

Triggers:

- A display inspection advisory trigger event.

VOLVO

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 12 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Use Case:

- The DMCU sends the inspection advisory to the TGW.
- The TGW displays the inspection advisory to the driver.
- When the vehicle leaves the geo-zone, the DMCU sends an inspection advisory deactivation message to the TGW.
- The TGW stops displaying the inspection advisory.

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 13 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

3 Task 4 Requirements

3.1 General

Req TASK4-002/1.0: DSRC WRI Message Security

All DSRC WRI communications shall be secured in accordance with the requirements of Reference [3].

Req TASK4-003/1.0: Inspection Request Message

The inspection request message shall be defined in Reference [3] and shall, as a minimum, contain the following information:

- Send inspection message geo-zone
- Request inspection advisory geo-zone

Req TASK4-004/1.1: Inspection Message

The inspection message shall be defined in Reference [3] and shall, as a minimum, contain the following vehicle inspection data:

- Tractor Information:
 - VIN
 - Weight per axle group
 - Tire Information (Pressure, Temperature) per tire
 - Brake Status (ABS, Stroke, Remaining Lining) per axle per side
 - Seat Belt Status
 - Lighting Status
- Trailer Information per trailer:
 - VIN
 - Position Behind Tractor
 - Weight per axle group
 - Tire Information (Pressure, Temperature) per tire
 - Brake Stroke Status per axle
 - Lighting Status
- Driver credentials:
 - License Information (Number, State, Issue Date, Expiration Date, Class)

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 14 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

- Name (Last, First, Middle)
- Address (Street, City, State, Zip Code)
- Position Information (Latitude, Longitude, Heading)

Req TASK4-005/1.0: Request Inspection Advisory Message

The request inspection advisory message shall be defined in Reference [3] and shall, as a minimum, contain the following information:

- Tractor VIN

Req TASK4-006/1.0: Inspection Advisory Message

The inspection advisory message shall be defined in Reference [3] and shall, as a minimum, contain textual information and/or instructions for the driver.

Req TASK4-007/1.0: Transaction Log/Archive Correlation

To the greatest degree reasonable, the entries in the transaction logs and archives maintained by the system components supporting the WRI Application shall support correlation between the systems to allow individual WRI Application message flows and actions to be tracked system wide.

Req TASK4-008/1.0: Transaction Log/Archive Time Stamps

To the greatest degree reasonable, the time stamps used in the transaction logs and archives maintained by the system components supporting the WRI Application shall use a common time standard (e.g. GPS) to allow individual WRI Application message flows and actions to be accurately timed system wide.

3.2 RSE WRI Service

Req TASK4-009/1.0: Inspection Request Broadcast Service

The RSE shall be capable of broadcasting an inspection request message as defined in Reference [3] which was received from a specified GBS via the IP Network.

Req TASK4-010/1.0: Inspection Message Routing

The RSE shall be capable of routing an inspection message as defined in Paragraph 3.1, which was received from a DMCU, over the IP Network to a specified GBS.

Req TASK4-011/1.0: Inspection Message Receipt Routing

The RSE shall be capable of routing an inspection message receipt as defined in Reference [3], which was received from a specified GBS via the IP Network, to the DMCU which originated the inspection message.

Req TASK4-012/1.0: Request Inspection Advisory Reception

The RSE shall be capable of routing a request inspection advisory message as defined in Reference [3], which was received from a DMCU, to a specified GBS over the IP Network.

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 15 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Req TASK4-013/1.0: RSE Message Routing

The RSE shall be capable of routing an inspection advisory message as defined in Reference [3], which was received from a specified GBS via the IP Network, to the DMCU that originated the request inspection advisory message for which this is a response.

Req TASK4-014/1.0: RSE Transaction Log

To the greatest degree reasonable, the RSE shall maintain a transaction log with time stamps for all messages and data connections that it handles.

Req TASK4-015/1.0: RSE Installation Options

The RSE running the WRI Service shall be capable of operating in either a fixed, roadside installation or a mobile, vehicle-based installation.

3.2.1 GBS Simulation

Req TASK4-016/1.1: RSE Simulation Engine

The RSE shall support a simulation engine which meets the remaining requirements specified in Paragraph 3.2.1 to support the testing and verification of the WRI Service in the absence of a GBS.

Req TASK4-017/1.0: Simulation Interface

To the greatest degree possible, the RSE simulation engine shall interface with the RSE WRI service without requiring a software change.

Req TASK4-018/1.0: Inspection Request Transmission

The RSE shall be capable of simulating the reception of an inspection request from the IP Network as defined in Reference [3] at a programmable interval.

Req TASK4-019/1.0: Inspection Request Generation

The RSE shall utilize a simple data source, which can be easily modified, to define the simulated inspection request.

Req TASK4-020/1.0: Inspection Message Acknowledgement

The RSE shall be capable of simulating the reception of an inspection message receipt from the IP Network as defined in Reference [3] for each received inspection message.

Req TASK4-021/1.0: Request Inspection Advisory Message Response

The RSE shall be capable of simulating the reception of an inspection advisory message from the IP Network as defined in Reference [3] for each received request inspection advisory message.

Req TASK4-022/1.0: Simulated Inspection Advisory Message

The RSE shall utilize a simple data source, which can be easily modified, to define the simulated inspection advisory.

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 16 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Req TASK4-023/1.1: Request Inspection Advisory Message Delayed Response

The RSE shall be capable of delaying the transmission of the simulated inspection advisory message for a defined number of inspection advisory requests to support testing the system behavior resulting from GBS processing delays.

Req TASK4-024/1.0: Simulation Mode Message Archive

While in simulation mode, the RSE shall archive the contents of all received and simulated inspection messages with a time stamp reflecting the time of reception or simulation of the message.

Req TASK4-025/1.0: Inspection Transaction Display

While in simulation mode, the RSE shall support the real-time display of a time-stamped list summarizing the inspection transactions in a simple, readable format sufficient to support the verification of the service as inspection requests are processed.

Req TASK4-026/1.0: Inspection Archive Review

The RSE shall support a simple, conceptual user interface sufficient to allow a historical analysis of the simulated service operation which allows for the review of the inspection archive.

3.3 DMCU WRI Application

Req TASK4-027/1.0: Inspection Request Message Reception

The DMCU shall be capable of receiving and caching inspection request messages, defined in Paragraph 3.1, that are broadcast by an RSE.

Req TASK4-028/1.0: Outdated Inspection Request Detection

The DMCU shall be capable of determining when an inspection request is outdated and shall delete all outdated inspection requests.

Req TASK4-029/1.0: Inspection Request Retention

The DMCU shall discard all cached inspection requests when powered down.

Req TASK4-030/1.0: Send Inspection Message Geo-Zone

After receipt of an inspection request, the DMCU shall:

- Request vehicle inspection data from the TGW as defined in Paragraph 3.1.
- Monitor the send inspection message geo-zone.

Req TASK4-031/1.0: Inspection Message Transmission

When the send inspection message geo-zone is satisfied and the TGW has returned the vehicle inspection data, the DMCU shall:

- Transmit an inspection message as defined in Paragraph 3.1
- Receive a message receipt acknowledgement

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 17 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Req TASK4-032/1.0: Inspection Message Transmission Failure

If the transmission of the inspection message is unsuccessful, the DMCU shall pause for 1 second and retry the transmission until the transmission is successful or the send inspection message geo-zone is no longer satisfied.

Req TASK4-033/1.0: Request Inspection Advisory Geo-Zone

When the inspection message transmission has been completed successfully, the DMCU shall monitor the request inspection advisory geo-zone.

Req TASK4-034/1.0: Request Inspection Advisory

When the request inspection advisory geo-zone is satisfied, the DMCU shall:

- Transmit a request inspection advisory message as defined in Reference [3]
- Receive the inspection advisory as defined in Reference [3]

Req TASK4-035/1.0: Request Inspection Advisory Failure

If the request inspection advisory is unsuccessful, the DMCU shall pause for a configurable period and retry the request until the request is satisfied or the request inspection advisory geo-zone is no longer satisfied.

Req TASK4-036/1.0: Request Inspection Advisory Geo-Zone

When an inspection advisory has been received, the DMCU shall monitor the display inspection advisory geo-zone.

Req TASK4-037/1.0: Display Inspection Advisory Request

When the display inspection advisory geo-zone is satisfied, the DMCU shall send the inspection advisory to the TGW as defined in Reference [4].

Req TASK4-038/1.0: Stop Inspection Advisory Display Request

When the display inspection advisory geo-zone is no longer satisfied, the DMCU shall send a stop inspection advisory display request to the TGW as defined in Reference [4].

Req TASK4-039/1.0: DMCU Transaction Log

To the greatest degree reasonable, the DMCU shall maintain a transaction log with time stamps for all transactions that it handles.

3.4 TGW WRI Application

Req TASK4-040/1.0: Collect Vehicle Inspection Data

When a request for vehicle inspection data as defined in Reference [4] is received from the DMCU, the TGW shall collect the required data and send it to the DMCU as defined in Reference [4].

Req TASK4-041/1.0: Driver Credentials

The driver credentials included in the vehicle inspection data shall be a by-product of the CVII Driver Credentials Validation Service as defined in Reference [6].

VOLVO

Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 18 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Req TASK4-042/1.0: Inspection Advisory Display

When an inspection advisory is received from the DMCU, the TGW shall display the inspection advisory to the driver as the highest priority traveler advisory.

Req TASK4-043/1.0: Stop Inspection Advisory Display

When a stop inspection advisory display is received from the DMCU, the TGW shall discard the inspection advisory.

Req TASK4-044/1.0: TGW Transaction Log

To the greatest degree reasonable, the TGW shall maintain a transaction log with time stamps for all transactions that it handles.



Document Number 6980-02941-01-10	Issue Number 1.1	Date 11-Jun-2010	Page 19 (20)
Author Company Volvo Technology	Author Department, Name Mike Siebert, 6980		Author Phone +1 (336) 393-3171
Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
Document Title C030588 CVII Task 4 [21-Jan-2009 to 31-Dec-2010]		Type of Document Concept of Operations	

Table of Requirements

Req TASK4-001/1.0: Requirement Identifier	5
Req TASK4-002/1.0: DSRC WRI Message Security	13
Req TASK4-003/1.0: Inspection Request Message	13
Req TASK4-004/1.1: Inspection Message.....	13
Req TASK4-005/1.0: Request Inspection Advisory Message	14
Req TASK4-006/1.0: Inspection Advisory Message	14
Req TASK4-007/1.0: Transaction Log/Archive Correlation.....	14
Req TASK4-008/1.0: Transaction Log/Archive Time Stamps	14
Req TASK4-009/1.0: Inspection Request Broadcast Service	14
Req TASK4-010/1.0: Inspection Message Routing	14
Req TASK4-011/1.0: Inspection Message Receipt Routing	14
Req TASK4-012/1.0: Request Inspection Advisory Reception	14
Req TASK4-013/1.0: RSE Message Routing	15
Req TASK4-014/1.0: RSE Transaction Log	15
Req TASK4-015/1.0: RSE Installation Options.....	15
Req TASK4-016/1.1: RSE Simulation Engine	15
Req TASK4-017/1.0: Simulation Interface.....	15
Req TASK4-018/1.0: Inspection Request Transmission.....	15
Req TASK4-019/1.0: Inspection Request Generation	15
Req TASK4-020/1.0: Inspection Message Acknowledgement.....	15
Req TASK4-021/1.0: Request Inspection Advisory Message Response	15
Req TASK4-022/1.0: Simulated Inspection Advisory Message	15
Req TASK4-023/1.1: Request Inspection Advisory Message Delayed Response	16
Req TASK4-024/1.0: Simulation Mode Message Archive.....	16
Req TASK4-025/1.0: Inspection Transaction Display	16
Req TASK4-026/1.0: Inspection Archive Review.....	16
Req TASK4-027/1.0: Inspection Request Message Reception.....	16
Req TASK4-028/1.0: Outdated Inspection Request Detection	16
Req TASK4-029/1.0: Inspection Request Retention.....	16
Req TASK4-030/1.0: Send Inspection Message Geo-Zone	16
Req TASK4-031/1.0: Inspection Message Transmission.....	16
Req TASK4-032/1.0: Inspection Message Transmission Failure	17
Req TASK4-033/1.0: Request Inspection Advisory Geo-Zone	17
Req TASK4-034/1.0: Request Inspection Advisory	17
Req TASK4-035/1.0: Request Inspection Advisory Failure	17
Req TASK4-036/1.0: Request Inspection Advisory Geo-Zone	17
Req TASK4-037/1.0: Display Inspection Advisory Request.....	17
Req TASK4-038/1.0: Stop Inspection Advisory Display Request	17
Req TASK4-039/1.0: DMCU Transaction Log	17
Req TASK4-040/1.0: Collect Vehicle Inspection Data	17
Req TASK4-041/1.0: Driver Credentials.....	17
Req TASK4-042/1.0: Inspection Advisory Display.....	18

VOLVO

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Customer Company New York State DOT	Customer Name Rick McDonough		Customer Phone +1 (518) 457-5871
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Req TASK4-043/1.0: Stop Inspection Advisory Display.....	18
Req TASK4-044/1.0: TGW Transaction Log	18